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(ii) Vol. 2–53 (1933–1989): Věstník československé společnosti zoologické (*Věst. Čs. Společ. Zool.*)
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This issue is dedicated to Professor Karel Hůrka
on occasion of his 65th birthday

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Professor Karel Hůrka 65 years old

We like to think that we are in control of our destiny, or that we are least able to influence the direction of our future Needless to say, this is far from the truth.

In 1941, during the Second World War, under the influence of my father and at the tender age of 10 years, I decided to collect beetles, a decision that was considered by most of my young friends as absolutely foolish. Little did I know at that time that this decision was one of the most fundamental decisions I ever made, that would profoundly influence my entire life. There were many of us at that time; for most, the interest to collect insects was just a temporary fascination, but many persisted. I was one of them, to a great extent thanks to the unconditional support of my father, and also to the fact that in my home town, Hradec Králové in eastern Bohemia, there were two coleopterists who put me on the right track from the beginning. As many other did, I turned my attention to the ground beetles and slowly, after lots of frustration, I was even able to put names on many of them Again, little did I know at that time that at the opposite end of Bohemia, there was another youngster, who was making a similar decision which, as in my case, also significantly influenced his entire life And yes, you guessed correctly, the other youngster was Karel Hůrka, and he is actually the reason why I am writing all this.

We first met at a meeting of the Entomological Society in Prague; then we occasionally met during the regular meetings of the Society, but eventually our relationship developed into friendship. When Karel started to study the carabid fauna of the Soos natural reserve (*Sphagnum* bog) near Františkovy Lázně in western Bohemia in the late fifties, I realized that this unique biotope might also reveal interesting species of Staphylinidae (a family to which I switched in the meantime). A joint collecting trip with Karel to Soos followed in the spring of 1960 that immediately reconfirmed the uniqueness of this habitat by producing the first record for the former Czechoslovakia of *Stenus kiesenwetteri*, a tyrphobiont species whose occurrence in Bohemia I suspec- ted for some time More collecting trips followed. One of them led us to eastern Slovakia in the spring of 1966 to collect in flood debris of the Latorica river to find *Pterostichus latoricaensis* recently described from that area by Pulpán (now known as *P piceolus latoricaensis*), with some additional collecting in southern Slovakia. After one of us discovered *Duvalius subterraneus* in eastern Slovakia for the first time, near Nová Sedlica, we decided to jointly revise the Carpathian species of the *Procerus* group. I still vividly remember the long evenings hours spent in Karel's office working on this project, while munching enormous amounts of peanuts that somehow were always available! We continued the study of trechines by working on another revision, this time of the *bielzi* group of the genus *Pseudanophthalmus*

This revision was the first step in the improvement of our knowledge of the trechines of the caves of the Slovak Karst, that has made such incredible progress recently. But this second paper was published while I was already in Canada; for political reasons, and after mutual agreement, Karel appeared as the sole author of it.

After I left Prague to take permanent residency in Canada, I was convinced that my „carabid days" were definitely over. I was wrong once again. In time I got involved, as a co-author, in papers on *Blethisa*, *Promecognathus*, *Paropisthius*, etc., and quite recently on *Elaphrus* During these times my contact with Karel was just occasional and we met only once, during the International Congress of Entomology in 1984 in Hamburg. Shortly after the downfall of the communist regime in the former Czechoslovakia, I visited Prague in the fall of 1990. Karel was one of the first of my entomological friends I visited, I cought him by surprise in his office at Viničná, that looked almost exactly as it did 30 years ago when we were munching peanuts there while working on our trechines! I enjoyed our long discussion in which Karel filled me in on all the progress achieved during my thirty-year absence, including his work on his carabid book, and on all those wonderfull species of ground beetles I would never have dreamed could be found on this small territory. I then realized that, although my interest had turned to other families of beetles, whether for scientific or existential reasons, I actually stayed faithful to my „first love", the ground beetles; and, little did I know at that time that I would eventually become closely involved with Karel's carabid book.

During my recent visit to Prague in the fall of 1995, I was asked if I could read and correct the English translation of Karel's book on the ground beetles of the Czech and Slovak Republics. This task intimidated me somewhat at first, but I accepted it, and never regretted it Not only did I learn a lot about carabids, but I also realized that I was actually quite priviledged to be the first within the scientific community to have the opportunity to read this outstanding book With every page I read, I further appreciated the amount of work that went into this project and the tremendous contribution this book would bring to the knowledge of the ground beetles not only of the former Czechoslovakia, but also of Central Europe in general. And again, I felt privileged to be able to contribute, at least in a small personal way.

There is not much left to say, except to congratulate Karel on his important life anniversary that finds him in excellent health, and to acknowledge his exceptional, varied achievements, both scientific and pedagogical, that are addressed in more detail elsewhere. There is no doubt in my mind that Karel will continue with undiminished energy along the same path in the future, and for that I wish him, as one of his friends, lots of energy and enthusiasm for many years to come. And, please, do not forget age, to a great extent, is a state of mind and that there is no reason why it should stand in your way for whatever you decide to do.

Ottawa, March 31, 1996 *A Smetana*

I am honoured that I was given the opportunity to join in the celebration of the significant anniversary of professor Hůrka by trying to describe my personal experience and appreciation of professor Hůrka. I studied under him and I finished both my diploma and PhD theses under his leadership I know him from lecture rooms, from excursions, I shared his office for several years, I played basketball and cards with him, we explored the caves of the Slovak Karst together, and we also used to drink beer in pubs.

Professor Karel Hůrka was born on June 2, 1931 in Domažlice, a town surrounded by the rough, picturesque nature of the Český les hills. And it was there where his love of nature was also born. While still a young child, he already started to collect rocks, plants, butterflies, and later on, when he acquired a collection of beetles of the Plzeň area through his father, especially the beetles. His father, a bank clerk, supported him tremendously. Professor Hůrka often tells about the beetle collecting trips he undertook together with his father and he still safeguards his first entomological collection box, made by his uncle who was a book binder. It was his father, who travelled to Prague in 1947 to personally visit Dr Leo Heyrovský, who at that time was the Secretary of the Entomological Society, to secure his son's membership in the Society. At the same time, he also bought the newly-published „Key to the family Carabidae" by Karel Kult for his son, which in fact initiated Hůrka's interest in ground beetles. Due to the relocation of the Domažlice branch of the bank his father worked for, after the annexation of the Sudety by Germans, the Hůrka family moved to Plzeň and spent the war years there. After the war, the family returned to Domažlice Unfortunately, Hůrka's father died in 1949. His mother, a pharmaceutist, provided an equal amount of support and managed to secure her son's education at the Charles University in Prague; and so, after his graduation from the J. Š. Baar high school in Domažlice, Karel Hůrka enrolled into the study program at the Faculty of Natural Sciences of the Charles University in Prague, choosing the field of special zoology with specialization in entomology. He studied with Prof. Julius Komárek, who deeply influenced his future activities. Another important stimulus was provided by the lectures of Prof. Jan Obenberger. Hůrka finished his studies in 1954 by successfully defending his diploma thesis dealing with the postembryonic development of may-beetles species *Melolontha hippocastani* This topic apparently had direct influence on his subsequent decision to concentrate on the study of insect ontogeny. In 1960, Hůrka successfully defended his candidate thesis dealing with the taxonomy, biology and ecology of the ectoparasitic insects of bats This topic was suggested by Prof. J. Komárek, who initiated a complex study of bats, a highly interesting and unjustly neglected group of animals This thesis initiated one part of our jubilarian's research activities that resulted in over 40 original papers, dealing with the comprehensive study of the fleas of the family Ischnopsyllidae and flies of the the families Nycteribiidae and Streblidae.

In 1969 Hůrka was given the title of assistant professor, after successfully defending his habilitation paper on larval taxonomy and reproductive cycles of the central European species of the genus *Carabus*. This work, started another field of study: larval taxonomy and biology of the reproduction of holometabo-

lous insects, mainly of the order Coleoptera, and of the family Carabidae in particular Up to now, Prof Hůrka has supervised 63 diploma theses, 22 of which were based on this topic, and out of 10 PhD and doctorate theses under his supervision, another five deal with the same topic

The study of the family Carabidae became the dominant field of our jubilarian's scientific activites, it includes not only the taxonomy of adults, but also faunistics and biocenology of the family, particularly within the Palaearctic Region In 1989 Prof Hůrka was awarded the DrSc degree after successful defence of a comprehensive work summarizing his broad knowledge of the breeding types and reproduction biology of the family Carabidae

Prof Hůrka's involvement with the Faculty of Natural Sciences of the Charles University goes back almost 43 years He started to work as a part time assistant at the Department of Systematic Zoology when he still was a grade 4 student, in 1954–1958 he worked as the assistent, and in 1958–1977 as special assistent He was awarded the title of assistant professor in 1969, but it was not until 1977 when he was actually appointed as the assistant professor at the Department of Systematic Zoology After the long desired political change in the country he was named the professor of Entomology From 1990 until 1994 professor Hůrka served as the head of Department of Zoology and at present he serves in the capacity of the deputy head of the department

It is hard to believe that it will be 50 years next year, since professor Hůrka joined the Czech Entomological Society He served for many years as the scientific secretary, then as the president and now as the vicepresident of the Society He also serves as the vicepresident of the Czech Zoological Society and he is the chief editor of the journal *Acta Societatis Zoologicae Bohemicae* He also is a member of the editorial board of the journal *Klapalekiana* and since 1986 he is the permanent member of the organizing commitee of the International symposia on the entomofauna of central Europe (SIEEC)

During recent times, Czech entomology had only very few personalities of Hůrka's distinctiveness and broad knowledge of the entire zoology After adding jubilant's vast and intensive pedagogical activity, we are looking also at a career of an outstanding university teacher, who established his own, distinctive entomological school, oriented particularly toward larval morphology and taxonomy, and adult taxonomy of Coleoptera Tens of specialists, many of them now recognized worldwide, graduated from this school

For the future, we particularly wish professor Hůrka good health and continuous success in his scientific and pedagogical activities, and at the same time also enough time to pursue his varied interests and hobbies

Prague, February 2, 1996 *Svatopluk Bílý*

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Description and key of larval Cicindelidae from Brazil (Coleoptera: Caraboidea)

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Abstract. The larvae of 15 species from 7 genera are described, including the first larval descriptions of representatives of *Aniara* Hope, 1838 (Megacephalini), *Cheilonycha* Lacordaire, 1843, and *Cenothyla* Rivalier, 1969 (Cicindelini). Larval characters of *Aniara* are very similar to those of *Megacephala* Latreille 1802, the gular suture is Y-shaped and the ventral double sclerite on the prementum is lacking. The bicolored pronotum and the absence of a spine on maxillary palpomere I distinguish the larva of *Aniara* from those of *Megacephala*. *Cheilonycha* and *Cenothyla* both have larval characters typical of the Cicindelini subtribe Prothymina. The gular suture is T-shaped and two pairs of hooks are present on tergite V. Larvae of *Cheilonycha* are distinguished from those of the similar genera *Odontocheila* Castelnau, 1834, *Cenothyla* and *Pentacomia* Bates, 1872 by less sclerotized, indistinct abdominal sclerites and by a pronotum with more than 40 setae and a setiferous posterolateral keel. It is possible to distinguish all described species of *Odontocheila*, *Cenothyla* and *Pentacomia* in the larval stage, but impossible to separate the larvae of these three genera at the generic level. *Cenothyla varians* (Gory, 1833) is different from the known larvae of *Odontocheila* and *Pentacomia* by the following character combination: yellow head capsule+pronotum with conspicuous long and dark setae anteriorly+flattened setae lacking. Short ecological notes on the species are given. A larval key is presented at the generic level, containing 12 of the 16 Brazilian cicindelid genera.

Larvae, larval key, Coleoptera, Cicindelidae, Neotropical region

INTRODUCTION

The tiger beetles (Cicindelidae) are a peculiar, worldwide adephagan group with about 120 genera and 2000 species. All tiger beetles are insect predators, and their larvae burrow characteristic holes where they wait for prey. More and more, tiger beetles are gaining importance in ecological and nature conservation research (Paarmann in press, Pearson 1980, 1988, 1992, Pearson et al. 1988, 1992). However, the larval knowledge is far from complete, especially in tropical groups (for a summary see Putchkov & Arndt 1994).

According to Reichardt (1977), 17 genera of Cicindelidae occur in Brazil. However, it is very unlikely that genus *Pseudoxycheila* Guérin, 1839 occurs in Brazil (Cassola pers. comm.). Zikan (1929) first gave detailed information about the biology of several Brazilian Cicindelidae, including data on the biology, illustrations of larval holes, and brief descriptions of the larval morphology of 9 genera. Using Zikan's material, van Emden (1935) provided more detailed descriptions of the larvae of Collyrinae with the Brazilian genus *Ctenostoma* Klug, 1821. A description of larval *Megacephala* Latreille, 1802, including both subgenera occurring in Brazil (*Phaeoxantha* Chaudoir, 1850 and *Tetracha* Hope, 1838) was prepared by Putchkov & Arndt (in press).

It is the aim of the present paper to describe the larvae of the genera *Aniara* Hope, 1838 (Megacephalini), *Cheilonycha* Lacordaire, 1843, and *Cenothyla* Rivalier, 1969 (Cicindelini)

for the first time and to describe new larvae of the genera *Pentacomia* Bates, 1872, *Odontocheila* Castelnau, 1834, *Cylindera* Westwood, 1831, and *Brasiella* Rivalier, 1954. So far, the larvae of 12 (75%) of the Brazilian Cicindelidae genera are known. A larval key to these genera is presented.

MATERIAL AND METHODS

The descriptions are based on the following larval material (L_1, L_2, L_3 refer to the larval instars I, II, and III) *Aniara sepulcralis* (9 L_3, 9 L_2, 3 L_1), Brazil, Manaus, Reserva Florestal Ducke, 1995; *Odontocheila cayennensis* (3 L_3, 4 L_2, 6 L_1) Brazil, Manaus, Reserva Florestal Ducke, 1992–1994; *O. chrysis* (3 L_2) Brazil, Manaus, Reserva Florestal Ducke 1992; *O. confusa* (1 L_3, 2 L_2) Brazil, Manaus, Várzea of Solimões River 1994, *O. luridipes* (4 L_3, 6 L_2) Brazil, Manaus, Reserva Florestal Ducke 1992, 1993; *O. margineguttata* (14 L_3, 15 L_2, 7 L_1) Brazil, Manaus, Reserva Florestal Ducke, 1992–1994, *Cenothyla varians* (10 L_3, 7 L_2, 15 L_1) Brazil, Manaus, Reserva Florestal Ducke 1992–1995; *Pentacomia egregria* (1 L_3, 1 L_2, 4 L_1) Brazil, Manaus, Varzea of Solimões River 1992; *Pentacomia lacordairei* (1 L_2, 7 L_1) Brazil, Manaus, Reserva Florestal Ducke 1992; *P. ventralis* (3 L_3, 3 L_2, 6 L_1) Brazil, Manaus, Reserva Florestal Ducke, 1992-1995, *Cheilonycha auripennis* (1 L_3) Brazil, Goiás, Mineiros, Facenda Saõ Francisco 17 10 89; *C. chalybea* (2 L_3, 3 L_2) Brazil, SP, Aguas de Santa Barbara, Campo Suju, coll L. R. Fontes 31 12 89 Larvae and adults of both *Cheilonycha* species were collected on termite hills *Cylindera suturalis* (6 L_3, 4 L_2, 1 L_1) Brazil, Manaus, Várzea of Solimões River 1994, 1995, *C. morio* (2 L_3) Brazil, Manaus, Reserva Florestal Ducke, 1992, 01.08 1995; *Brasiella argentata* (3 L_3, 3 L_2, 1 L_1) Brazil, Manaus, Reserva Florestal Ducke, 09.11 1992, 02 08.1995

Material of all species includes reared ex ovo larvae and field collected larvae, except that of *Odontocheila luridipes* and *O. chrysis* (reared ex ovo only) and that of both *Cheilonycha* species (field collected only) Larval specimens of all species are in the collection of INPA, Manaus and in the collection of E. Arndt (Leipzig), except those of *Cheilonycha auripennis* and *C. chalybea* which are in the collection of the ZMUSP

Larvae of the Brazilian genera *Ctenostoma* (6 species), *Megacephala* (4 subgenera, 9 species), *Oxycheila* Dejean, 1825 (*O. tristis* Fabricius, 1775), *Euprosopus* Dejean, 1825 (2 species), *Iresia* Dejean, 1831 (3 species), *Cylindera* (3 subgenera, 4 species), and *Brasiella* (2 species), and representatives of 17 further genera were available for comparison

The nomenclature follows Rivalier (1971); terms of morphology and chaetotaxy follow Knisley & Pearson (1984) and Putchkov & Cassola (1994).

Abbreviations: INPA – Instituto Nacional de Pesquisas da Amazonia (Manaus). ZMUSP – Museu de Zoologia da Universidade de Saõ Paulo

Characters of chaetotaxy (see Bousquet & Goulet 1984): gMX – setal group on stipes dorsally and dorsobasally TE_{11} – small seta on tergites I–VIII posteriorly in the middle

Number, size and position of stemmata, and the shape of the mandible and legs are equally in all described taxa. These characters are typically for all Cicindelidae larvae (see e. g. Hamilton 1925 or Knisley & Pearson 1984).

DESCRIPTIONS

Megacephalini

Aniara sepulcralis (Fabricius, 1801)
(Figs 1–4, 33)

Instar III

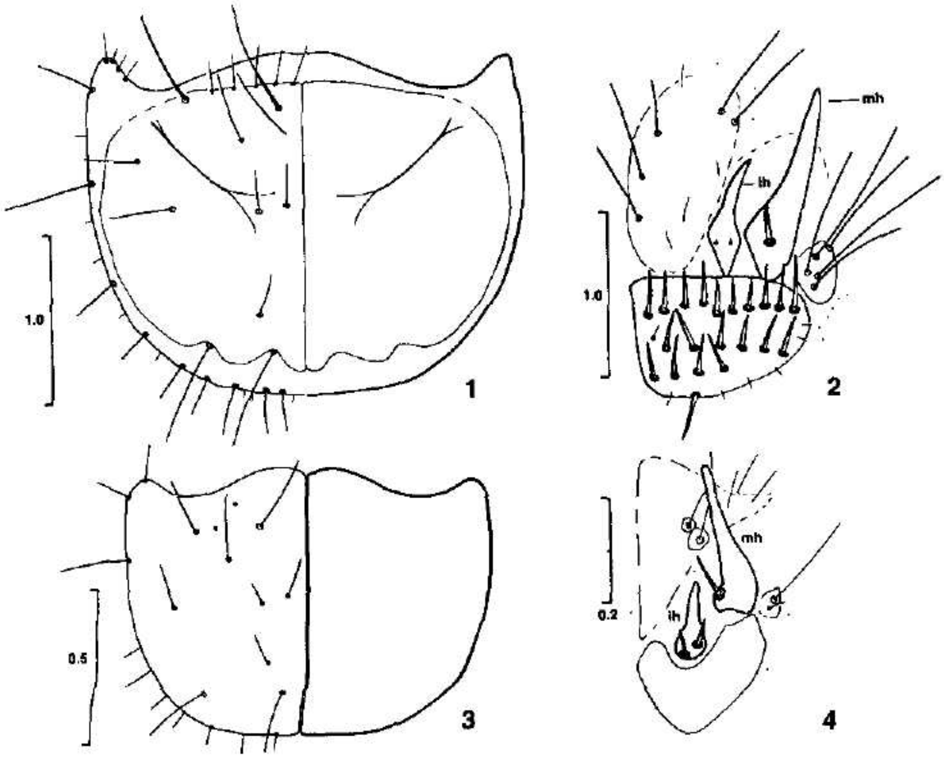
COLORATION. Head dark brown with metallic bronze lustre dorsally, light brown ventrally, pronotum bicolored, medial and anterior parts dark brown with bronze lustre, lateral and posterior margin pearl-white; legs and anterior part of mesonotum brown, rest of thoracal and abdominal sclerites pale; all setae dark brown.

HEAD. Nasale produced, wide, anterior smooth, limited on outer side by two large teeth; coronal suture very short; ridge on posterior part of frontale transverse, continued with ridge on vertex, each side of vertex ridge with 2, frontal ridge with 3 setae; between stemma I and II a small tubercle with 2 setae. Ventral part of head bag-shaped enlarged in posterior direction (visible from lateral view), gular suture Y-shaped. Antennomeres I and II much thicker than antenno-

meres III and IV, IV a little shorter than III and half as long than II and I; antennomeres I and II each with 8 or more setae, appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 or 3 distinct spines, setal group gMX with 40–45 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 8 setae and attaching the galea; galeomere I with 3 large and 1 small setae, galeomere II with 7 setae; ventral double sclerite on prementum lacking (Fig. 33), labial palpomere I with 2 setae apically, palpomere II with 1 seta mesally. Setae of normal shape, not flattened.

THORAX. Pronotum (Fig. 1) comparatively stout with a distinct groove on disk and 11–12 strong setae on each half; anterolateral angles produced. Setae on pronotum not flattened.

ABDOMEN. Tergites I–IV with 12–18 long and 14–20 short setae; segment V comparatively strong enlarged dorsally, tergite V (Fig. 2) 3-segmented with 2 pairs of hooks; inner hooks long and slender with 2 nearly reduced setae, median hooks slender and straight with 1 bristle basally; anterior part of tergite V with 8 or more setae, not completely separate from lateral part, the latter with 4–7 long setae, posterior part with 20–22 bristles and some fine and short setae. Epipleuron and hypopleuron each consisting of 2 sclerites with 4–8 (rarely more) setae. Posterior margin of tergite IX with 6 long setae. Pygopod with 8–10 strong and 10 or more fine setae dorsally and 16–18 bristles on apical margin.



Figs 1–4. *Aniara sepulcralis*, 1 – pronotum L_3, 2 – abdominal tergite V, right side L_3, 3 – pronotum L_1, 4 – abdominal tergite V, right side L_1 (ih–inner hook, mh–median hook) (scales in mm).

Instar II

The following character states are different from the third instar larva

HEAD Antennomeres I and II each with 5–7 setae, galeomere I with 3 bristles, galeomere II with 5 bristles, palpifer with 5 setae, setal group gMX on stipes with 32–38 setae

ABDOMEN Tergites I–IV with 8–10 long and 6–8 short setae Lateral part of tegite V with less setae

Instar I

The following character states are different from the second instar larva

COLORATION Pronotum unicolored, head pronotum, mesonotum and legs dark brown

HEAD Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with 20–25 setae

THORAX Pronotum (Fig 3) without groove or elevations, each side with 9 setae, anterolateral angles rounded

ABDOMEN Tergite I with 3 long and 5 short setae, tergites II–IV with 3 long and 3 short setae Tergite V (Fig 4) with 6–8 setae on anterior part and 2 on lateral part, setae lacking on posterior part, bristles on inner hooks large, not reduced Epipleuron and hypopleuron each with 1 large sclerite with 2–3 setae Small sclerite not distinct Pygopod with 2 setae dorsally, 10 on apical margin

Remarks

The larva of *Aniara sepulcralis* is very similar to larvae of *Megacephala* (see Putchkov & Arndt in press) The gular suture is Y-shaped and the ventral double sclerite on the prementum is lacking in both genera Contrary to the known larvae of *Megacephala*, the larva of *Aniara* has a bicolored pronotum Larvae of *Megacephala* are characterized by a spine on the lateroapical side of maxillary palpomere I, which is lacking in *Aniara*

The larvae of *Aniara sepulcralis* were found in an area with sparse vegetation near Manaus The clay soil was covered with a 10 cm deep sand layer at the locality The larval holes are slightly oblique and have a depth of only 6 cm in the first instar and 12–15 cm in the last instar

Cicindelini

Odontocheila cayennensis (Fabricius, 1787)
(Figs 5–8)

Instar III

COLORATION Head brown to dark brown with green lustre, pronotum yellow brown, rest of sclerites light brown Setae pale or brown

HEAD Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth, coronal suture very short, ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae Setae on head capsule not flattened Ventral part of head not enlarged in posterior direction, gular suture T-shaped Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae, appendage on antennomere III lacking, maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with 35–40 setae, lacinia lacking, stipes with a sclerotized bar apically, palpifer with 5 setae and attaching the galea, galeomere I with 3 strong setae, galeomere II with 4 bristles, ventral double sclerite on

prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta basally.

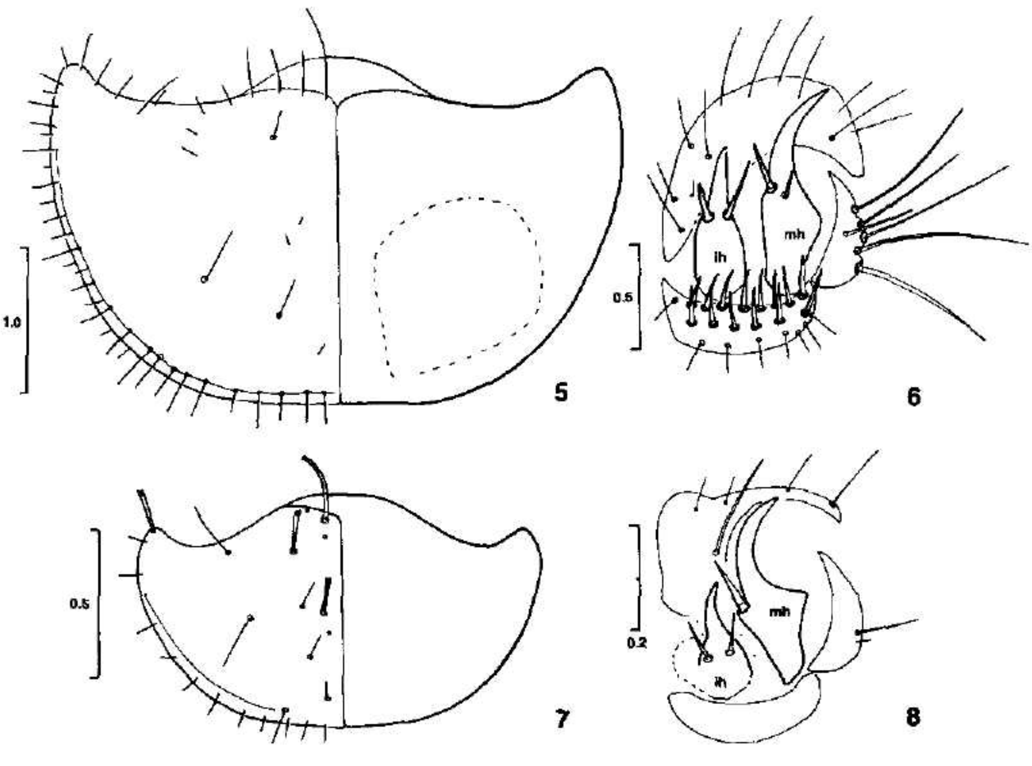
THORAX. Pronotum (Fig. 5) with anterolateral angles produced, rounded; chaetotaxy of pronotum reduced, only 3 short setae per half distinct. Setae of pronotum not flattened; no grooves or elevations distinct.

ABDOMEN. Tergites I–IV only with primary 4 long and 2–4 very short setae; tergite V (Fig. 6) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with 2 bristles; anterior part of tergite V with 10–14 long setae, lateral part with 5–7 long setae, posterior part with 12–17 bristles and 4–7 thin setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 6–7, that of hypopleuron with 5–8 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 8 strong setae dorsally, 14–16 on apical margin and a lot of short, thin setae laterally and ventrally.

Instar II

The following character states are different from the third instar larva:

HEAD. Galeomere I with 2, galeomere II with 4 setae, palpifer with 3–4 setae, gMX group with about 25–30 setae, labial palpomere I with 3 setae and 3 spines.



Figs 5–8. *Odontocheila cayennensis*, 5 – pronotum L_3, 6 – abdominal tergite V, right side L_3, 7 – pronotum L_1, 8 – abdominal tergite V, right side L_1 (ih–inner hook, mh–median hook) (scales in mm).

ABDOMEN. Anterior part of tergite V with 10–12 long setae, lateral part with 3 setae, posterior part with 10–14 bristles. Epipleuron with 4–5 setae on the large and 1 seta on the small sclerite, hypopleuron with 3–6 setae on the large and 1 seta on the small sclerite. Pygopod with 12 setae apically.

Instar I

The following character states are different from the second instar larva:

COLORATION. Head paler brown.

HEAD. Frontal part of ridge without setae. Setae near eyes flattened. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with about 20 setae, labial palpomere I ventroapically with 3 spines but without setae.

THORAX. Pronotum (Fig. 7) with 5 distinct, flattened setae.

ABDOMEN. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 8) with 4 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron and hypopleuron each with 2–3 setae on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Odontocheila confusa (Dejean, 1825)
(Figs 9, 10)

Instar III

COLORATION. Head and pronotum yellow brown, only region of eyes dark brown, rest of sclerites light brown. Setae striking dark brown.

HEAD. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule in part flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with about 25 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta below the middle.

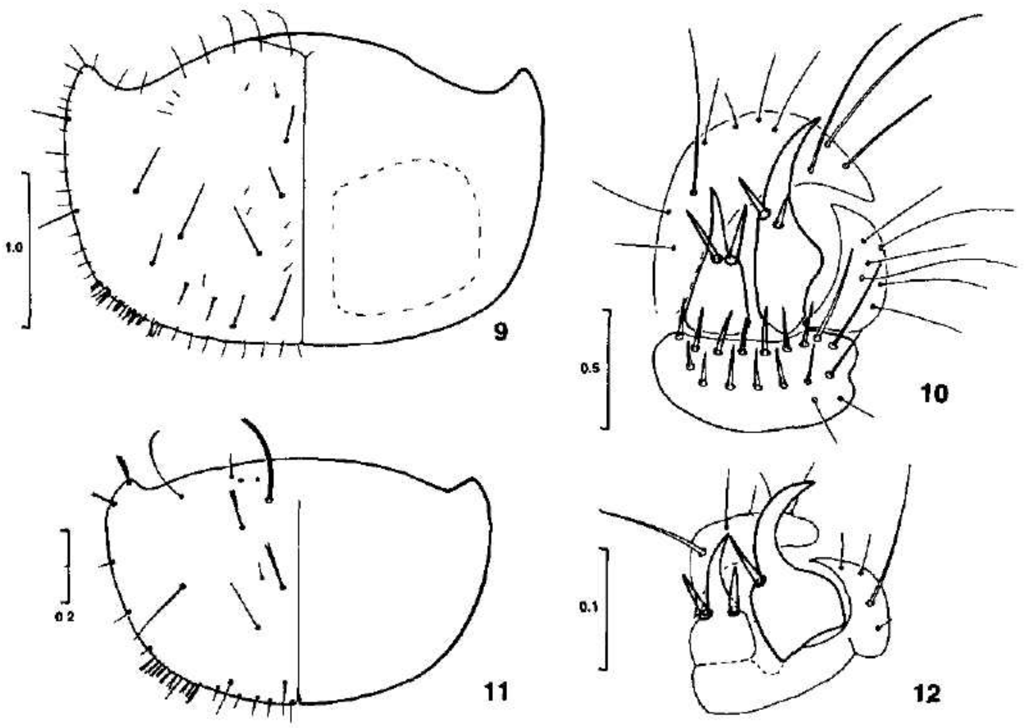
THORAX. Pronotum (Fig. 9) with anterolateral angles produced, rounded, 14–16 distinct setae per half, setae in part flattened; no grooves or elevations distinct. Meso- and metanotum with a number of long, striking dark setae.

ABDOMEN. Tergites I–IV with 8–10 setae arranged in 3 groups, base of setal groups distinctly more sclerotized than rest of tergites; tergite V (Fig. 10) with 3 separate parts and 2 pairs of hooks; inner hooks slender with 2 bristles, median hooks long and slender with 2 bristles; anterior part of tergite V with 10–12 long setae, lateral part with 4–6 long setae, posterior part with 14–16 bristles and setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 4–5, that of hypopleuron with 5–8 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long setae dorsally, 14 on apical margin.

Instar II
The following character states are different from the third instar larva:
HEAD. Galeomere I with 2, galeomere II with 4 setae, palpifer with 3 setae, gMX group with about 20–25 setae, stipes with 2 spines, labial palpomere I with 3 setae and 3 spines.
ABDOMEN. *Pygopod with 12 setae apically.*

Odontocheila luridipes (Dejean, 1825)
(Figs 11, 12)

Instar II
COLORATION. Head and pronotum pale yellow brown, only region of eyes dark brown to black, rest of sclerites pale yellow. Setae pale brown.
HEAD. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae near eyes flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 4–5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 distinct spines, setal group gMX with less than 16 setae,



Figs 9–12 9–10 – *Odontocheila confusa*, 9 – pronotum L_3, 10 – abdominal tergite V, right side L_3 (scales in mm) 11–12 – *Odontocheila luridipes*, 11 – Pronotum L_1, 12 – abdominal tergite V, right side L_1 (scales in mm).

lacinia lacking; stipes with a sclerotized bar apically, palpifer with 3–4 setae and attaching the galea; galeomere I with 2 strong setae, galeomere II with 4 bristles; ventral double sclerite on prementum present, labial palpomere I with 3 setae and 3 spines apically, palpomere II with 1 seta basally.

THORAX. Anterior margin of pronotum (cf. Fig. 9) strongly arched with anterolateral angles prominent, 14–20 setae per half distinct, some of them flattened; no grooves or elevations distinct.

ABDOMEN. First abdominal tergites with 5 (tergite I) to 8 (tergite IV) long setae and 2–4 very short setae; tergite V (cf. Fig. 10) with 3 slightly sclerotized and slightly distinct parts and 2 pairs of hooks; both hooks with 2 bristles basally, median hooks comparable stout and arched; anterior part of tergite V with 10 or more fine setae, lateral part with 4–5 setae, posterior part with 11–16 bristles. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 3–5, that of hypopleuron with 3–8 setae; the small sclerites each with 1–2 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long setae dorsally, 12–16 on apical margin.

Instar I

The following character states are different from the second instar larva:

HEAD. Frontal part of ridge without setae. Antennomere I without setae, II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with about 10–15 setae, labial palpomere I ventroapically with 3 spines but without setae.

THORAX. Pronotum (Fig. 11) with 7 distinct, flattened setae.

ABDOMEN. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 12) with 4 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron and hypopleuron each with 2–3 setae on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Odontocheila margineguttata (Dejean, 1825)

(Figs 13, 14)

Instar III

COLORATION. Head, pronotum and mesonotum dark brown with green-bronze lustre; rest of sclerites light brown. Setae pale brown.

HEAD. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule in part flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with about 20 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta basally.

THORAX. Pronotum (Fig. 13) with anterolateral angles prominent, 10–14 setae per half, setae in part flattened; anterior margin with several obvious long and pale setae; no grooves or eleva-

tions distinct. Lateral margin of pronotum in posterior part with separate edge, posterior angles with a tuft of pale setae. Meso- and metanotum with comparable few setae.

ABDOMEN. Tergites I–IV with 5 long and a number of very short setae; tergite V (Fig. 14) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with of 2 bristles; anterior part of tergite V with 12–15 setae, lateral part with 4–6 setae, posterior part with 10–14 bristles and 6–10 thinner setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 5–6, that of hypopleuron with 4–5 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long and several short setae dorsally, 14–16 on apical margin and a lot of short, thin setae laterally and ventrally.

Instar II

The following character states are different from the third instar larva:

HEAD. Galeomere I with 2, galeomere II with 5 setae, palpifer with 4 setae, stipes with 2–3 spines, setal group gMX with about 15 setae, labial palpomere I with 3 setae and 3 spines.

THORAX. Pronotum with 8 distinct setae per half.

ABDOMEN. Anterior part of tergite V with 10–14 long setae, lateral part with 3–4 setae, posterior part with 14–17 setae and bristles. Pygopod with only 6 long 12 setae dorsally and 12–14 apically.

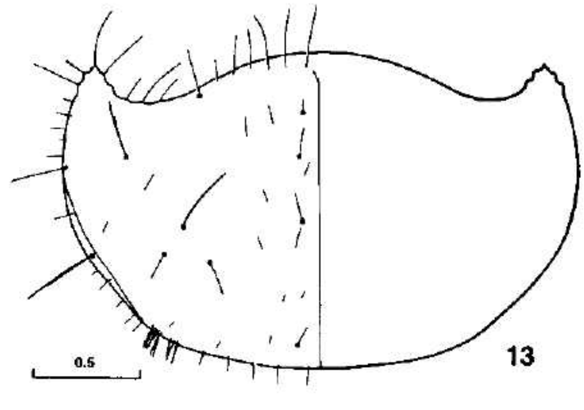
Instar I

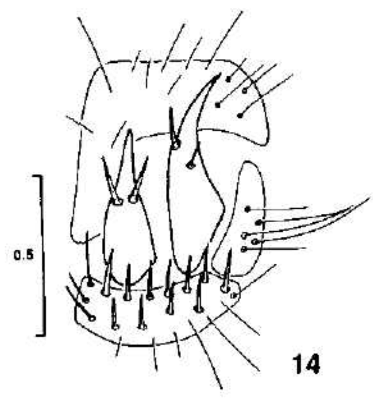
The following character states are different from the second instar larva:

COLORATION. Head, pronotum and mesonotum paler brown, head and pronotum with slightly lustre, mesonotum without lustre.

HEAD. Frontal part of ridge without setae. Seate near eyes flattened. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, labial palpomere I ventroapically with 3 spines but without setae.

THORAX. Pronotum (cf. Fig. 17) including the anterior margin with 10 flattened setae, anterior margin in the middle with obviously long, dark setae.





Figs 13–14. *Odontocheila margineguttata*, 13 – pronotum L_3, 14 – abdominal tergite V, right side L_3 (scales in mm).

Abdomen. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (cf. Fig. 18) with 5 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron with 2 setae on large sclerite, without setae on small sclerite, hypopleuron with 1 seta on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Remarks

The second instar specimens of *Odontocheila chrysis* (Fabricius, 1801) studied are very similar to the second instar of *O. margineguttata*. Only the measurements (see Table 1) and the slightly different number of pronotal setae (*O. chrysis* 11, *O. margineguttata* 8 in second instar) distinguish both species.

Larvae of *Odontocheila cayennensis*, *O. luridipes*, and *O. margineguttata* were collected on places without leaf litter in the examined Terra Firme forest near Manaus. Larvae of *O. margineguttata* show a preference of ground elevations like termite nests. The three species are associated with *Cenothyla varians* and *Pentacomia* (*Poecilochila*) *lacordairei* (Gory, 1833) (see Paarmann et al. in press).

Cenothyla varians (Gory, 1833)
(Figs 15–18, 34)

Instar III

Coloration. Head and pronotum pale reddish-brown without distinct lustre, only region near eyes dark brown, rest of sclerites light brown. Setae yellow to dark brown.

Head. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule not flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2–3 spines, setal group gMX with about 20 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 5 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta basally.

Thorax. Pronotum (Fig. 15) with anterolateral angles triangular, 12–18 setae per half, anterior margin with a row of obvious long and dark setae; setae not flattened, all setae pale except the dark setae on anterior margin; posterior angles with a tuft of pale setae; no grooves or elevations distinct on
pronotum.

Abdomen. Tergites I–IV with about 8 long and 2–4 very short setae; tergite V (Fig. 16) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks stout with 2 bristles near the middle; anterior part of tergite V with 10–14 setae, lateral part with 5–6 setae, posterior part with 12–16 bristles and 2–4 thinner setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerites with 4–7, the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long and several short setae dorsally, 14–16 on apical margin.

Instar II

The following character states are different from the third instar larva:

HEAD. Galeomere I with 2, galeomere II with 5 setae, palpifer with 2 setae, stipes with 2 spines, setal group gMX with 12–15 setae, labial palpomere I with 2–3 setae and 3 spines.

ABDOMEN. Anterior part of tergite V with 10–14 long setae (like third instar), lateral part with 3–5 setae, posterior part with 8–10 bristles and 2 setae. Pygopod with 12 setae dorsally and 12 apically.

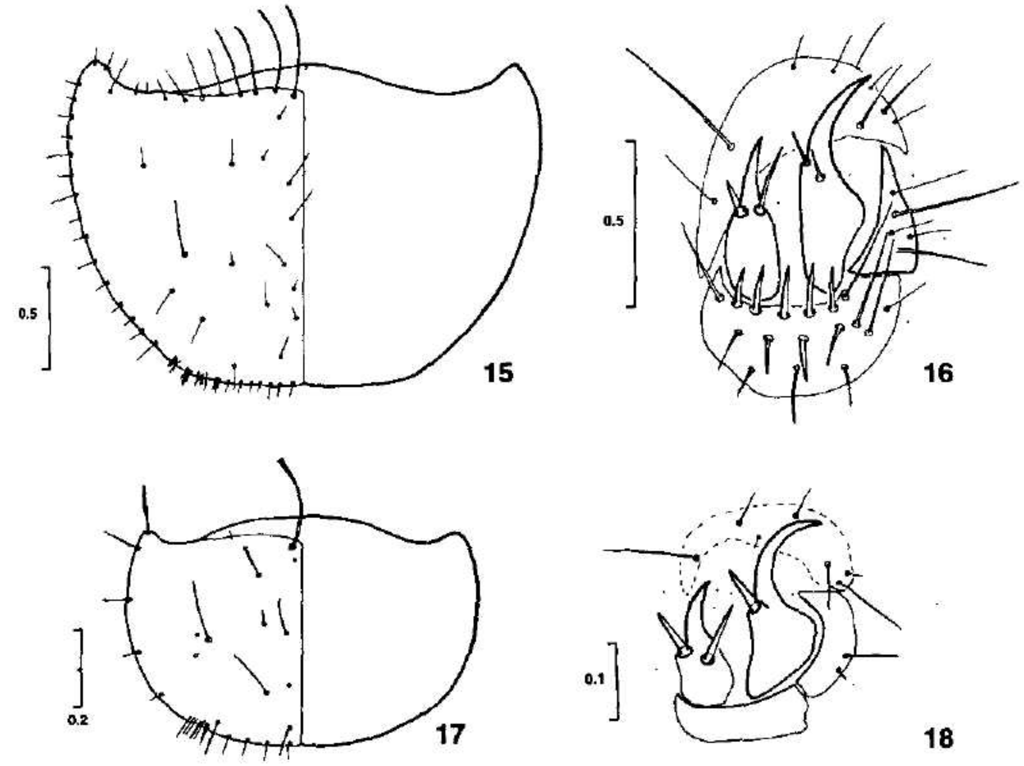
Instar I

The following character states are different from the second instar larva:

COLORATION. Head, pronotum and mesonotum paler brown, head and pronotum with slightly lustre, mesonotum without lustre.

HEAD. Frontal part of ridge without setae. Seate in part flattened. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer without setae, stipes with 1 spine basally, setal group gMX with 8–10 setae, labial palpomere I ventroapically with 3 spines but without setae.

THORAX. Pronotum (Fig. 17) including the anterior margin with 10 flattened setae, anterior margin in the middle with 2 obviously long and dark setae.



Figs 15–18. *Cenothyla varians*, 15 – pronotum L_3, 16 – abdominal tergite V, right side L_3, 17 – pronotum L_1, 18 – abdominal tergite V, right side L_1 (scales in mm).

Tab. 1. Measurements of examined Cicindelidae larvae, all data in mm, average in parenthesis

	Head width	Frontal width	Pronotal width	Pronotal length
Aniaria sepulcralis				
L_3	2.64–2.92 (2.77)	1.64–1.80 (1.76)	2.60–2.92 (2.71)	1.96–2.12 (2 03)
L_2	1.72–1.92 (1 83)	1 12–1.16 (1 14)	1.72–1.84 (1.76)	1 24–1 36 (1 31)
L_1	1.18, 1.24	0 76, 0 80	1.12, 1 16	0 82, 0 94
Odontocheila cayennensis				
L_3	3 31	1.93–2 00 (1 97)	3 43–3 50 (3.48)	2 06–2.19(2 16)
L_2	*2.12–2 24 (2 18)*	*1.28–1.36 (1.32)*	*2 16–2.20 (2 18)*	*1 20–1 28 (1 24)*
L_1	1.40–1.52 (1 48)	0 84–0 88 (0 87)	1 20–1.48 (1 39)	0.80–0.88 (0 84)
Odontocheila chrysis				
L_2	1.36–1.38 (1.37)	0.72–0.76 (0 74)	1 40–1.44 (1.42)	0.80–0 84 (0 82)
Odontocheila confusa				
L_3	2 80	1.60	3 08	2.08
L_2	1 84–1 92 (1.88)	1.00–1.08 (1 04)	1 84–1.92 (1.88)	1.28
Odontocheila luridipes				
L_2	1 76–1.88 (1.82)	0 88–1 00 (0 92)	1.84–1 92 (1.87)	1 10–1 16 (1.12)
L_1	1.12–1.20 (1.16)	0 60–0 64 (0 62)	1 08–1 20 (1 14)	0 64–0.76 (0 69)
Odontocheila margineguttata				
L_3	2 28–2 60 (2 42)	1.36–1.44 (1 40)	2 44–2 60 (2.51)	1 54–1 68 (1 61)
L_2	1 48–1 56 (1.53)	0 84–0 96 (0 89)	1.48–1 68 (1 54)	0 92–1 04 (0 96)
L_1	0 90–1.06 (0 98)	0 50–0 60 (0 55)	0 84–1 02 (0 93)	0 50–0 60 (0 57)
Cenothyla varians				
L_3	2.32–2 60 (2 46)	1.28–1 44 (1 38)	2 40–2.64 (2 53)	1 60–1 72 (1 67)
L_2	1.28–1.44 (1 39)	0.80–0.84 (0 83)	1 48–1 56 (1 51)	0.92–1 00 (0.97)
L1	0.70–0 98 (0.84)	0.48–0.58 (0.51)	0.80–0.96 (0.90)	0.54–0.60 (0.57)
Pentacomia egregria				
L_3	2.00	1.16	2.08	1 28
L_2	1.20	0.68	1.20	0 80
L_1	*0 68–0 72 (0 70)*	*0 40*	*0 65–0.68 (0 66)*	*0.42–0.43 (0 42)*
Pentacomia lacordairei				
L_2	1 01	–	1 11	–
L_1	0 68–0 78 (0.71)	0.50–0.58 (0 54)	0 70–0 74 (0.72)	0 42
Pentacomia ventralis				
L_3	2.32–2 64 (2 50)	1 28–1 44 (1 37)	2 40–2.64 (2 52)	1 52–1 60 (1.56)
L_2	1 56–1 64 (1 61)	0 77–0 80 (0 79)	1 52–1 64 (1 60)	1 05–1 08 (1 07)
L_1	1 00–1 02 (1 01)	0 52	0.92–0 98 (0 96)	0 88
Cheilonycha auripennis				
L_3	2.81	1.62	3.00	2.25
Cheilonycha chalybea				
L_3	2 94, 3 00	1 75, 1.75	3 19, 3 25	2.25, 2 25
L_2	1 75–1.97 (1.88)	1 06–1 19 (1.12)	1 93–2 08 (2.02)	1 34–1.38 (1.36)
Cylindera morio				
L_3	2 08	1.20	2 08	1.32
Cylindera suturalis				
L_3	2.00–2.20 (2.10)	1.20–1 28 (1.24)	1.92–2 08 (2 00)	1 20–1.24 (1.23)
L_2	1.42–1.48 (1 46)	0 88–0 96 (0 94)	1.32–1.40 (1 36)	0 86–0.92 (0 90)
L_1	1.02	0.60	0.90	0.58
Brasiella argentata				
L_3	1 56–1 68 (1 61)	0 85–0 90 (0 88)	1.48–1 64 (1 55)	0 85–0 92 (0 88)
L_2	0.99–1 01 (1 00)	0 57–0 61 (0 60)	0 93–1.00 (0.98)	0 61–0 65 (0.63)
L_1	0.62	0.36	0 59	0 36

ABDOMEN Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 18) with 2–6 setae on anterior part and 1 long and 1 short seta on lateral part, setae lacking on posterior part. Median hooks short, strongly arched with 1 short bristle. Epipleuron with 2 setae on large sclerite, without setae on small sclerite, hypopleuron with 1 long and 1 pore-like seta on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Remarks

The larva of *Pentacomia* (*Poecilochila*) *lacordairei* (only first and second instars were available) is very similar to that of *Cenothyla varians*. The first instar of both species is distinguished only by measurements (see Table 1), the second instar is distinguished beside the measurements, by the mesonotum and metanotum of *P. lacordairei* having fewer setae and median hooks only with one seta. But only 1 second instar specimen of *P. lacordairei* was examined. *Pentacomia ventralis* (Dejean, 1825) is distinguished from *P. lacordairei* (same subgenus!) by the slender median hooks, more setae on first antennomeres and palpifer, the multisetose posterior margin of the mesonotum and the third pair of setae on posterior margin of abdominal tergite IX.

Cenothyla varians and *P. lacordairei* occur together in the examined Terra Firme forest near Manaus. Larvae of both species were collected on places without leaf litter in the forest. *Pentacomia lacordairei* was also collected in inundation forests of the Solimoes River near Manaus (see Adis et al. in press).

***Pentacomia* (s. str.) *egregria* (Chaudoir, 1835)**
(Figs 19–22)

Instar III

COLORATION Head dark brown to black with slightly metallic lustre, pronotum brown, anterolateral angles of pronotum yellowish, rest of sclerites brown. Setae brown, pale or black.

HEAD Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth, coronal suture very short, ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae, posterior part of head with flattened setae. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 6–8 setae, 3 of them long setae and on inner margin, antennomere II with 6–7 setae, the posteroapical seta obviously flattened and contrary to the other setae black, appendage on antennomere III lacking, maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 distinct spines, setal group gMX with 16–20 setae, lacinia lacking, stipes with a sclerotized bar apically, palpifer with 6 setae and attaching the galea, galeomere I with 3 strong setae, galeomere II with 5 bristles, ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta below the middle.

THORAX Pronotum (Fig. 19) with anterolateral angles prominent, only 10 setae on each half, the anterior 3 togeher with 3 on anterior margin flattened, and contrary to the pale and thin other setae black coloured, no grooves or elevations distinct.

ABDOMEN Tergites I–IV with 16–26 setae per half, tergite V (Fig. 20) with 3 separate parts and 2 pairs of hooks, both hooks long and slender, with 2 bristles, median hooks with 1 bristle in the apical half and the other basally, anterior part of tergite V with 6–8 thin setae, lateral part with 3–4 setae, posterior part with 7–8 bristles and 7–8 setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerites with 8–10, the small with 2–3 setae. Posterior

margin of tergite IX with 3 pairs of long setae. Pygopod with about 10 distinct and some thin and very short setae dorsally and 14–16 on apical margin.

Instar II

The following character states are different from the third instar larva:

HEAD. Antennomere I with 6, antennomere II with 5 setae, the black and flattened seta less distinct, galeomere I with 2 setae, palpifer with 3 setae.

THORAX. Pronotum with less distinct flattened black setae in anterior region.

ABDOMEN. Anterior part of tergite V like third instar with 6–8 long setae, but lateral part with 2–3 setae, posterior part with 6–8 bristles and 6–8 thin setae.

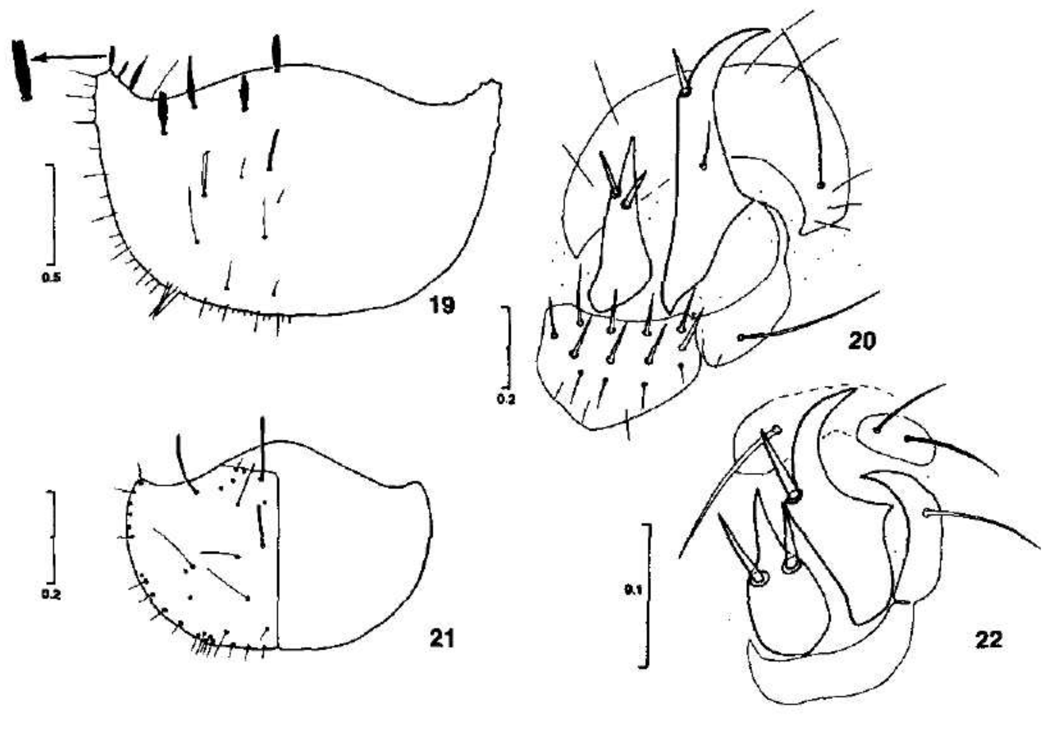
Instar I

The following character states are different from the second instar larva:

HEAD. Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with less than 16 setae, labial palpomere I ventroapically with 3 spines but without setae.

THORAX. Pronotum (Fig. 21) with 10 setae, anterior like those of head long and flattened, but black and darker than the rest of setae.

ABDOMEN. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 22) with 3–4 setae on anterior part and 1 seta on



Figs 19–22. *Pentacomia egregria*, 19 – pronotum L_3, 20 – abdominal tergite V, right side L_3, 21 – pronotum L_1, 22 – abdominal tergite V, right side L_1 (scales in mm).

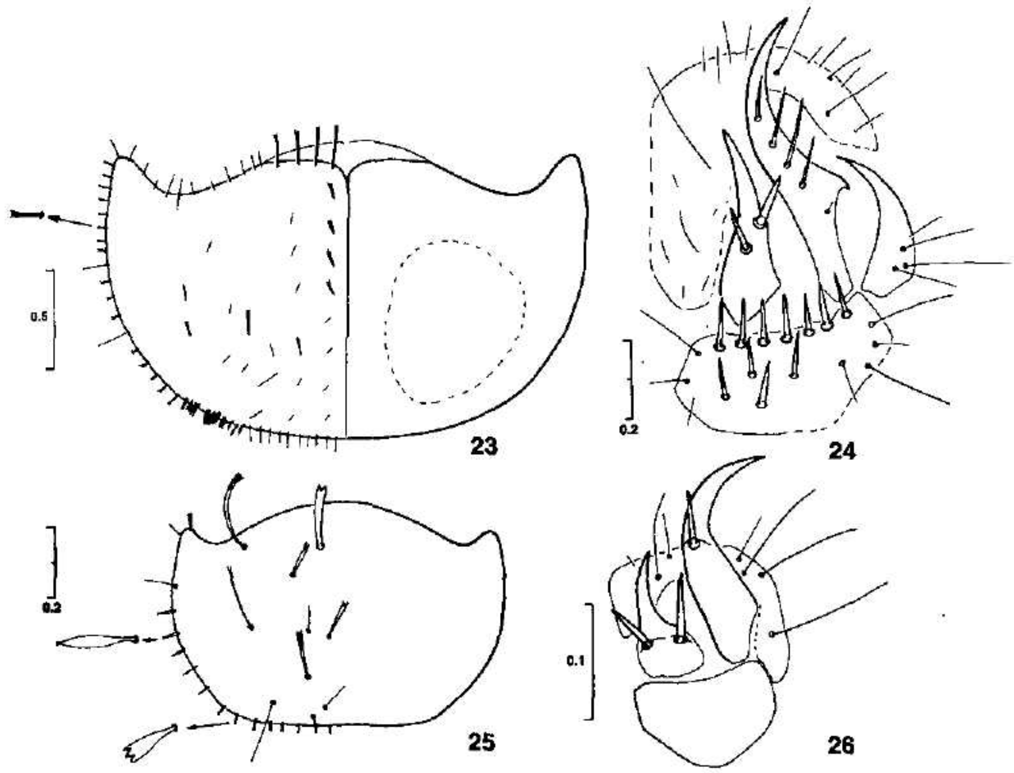
lateral part, setae lacking on posterior part. Median hooks with 1 seta. Epipleuron and hypopleuron each with 1 large and 1 small sclerite, the large sclerites with 2 setae, the small sclerites without setae. All abdominal setae compareably long. Pygopod with 4 long setae dorsally, 8 on apical margin.

Pentacomia* (*Poecilochila*) *ventralis (Dejean, 1825)
(Figs 23–26)

Instar III

Coloration. Head and pronotum brown, region near eyes darker, brown to black with green lustre; anterolateral angles of pronotum and appendages of head paler; rest of thoracal and abdominal sclerites light brown. Setae pale or brown.

Head. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2–3 flattened setae, setae on head capsule pale, those near eyes flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomeres I and II much thicker than III and IV, I–III of nearly the same



Figs 23–26. *Pentacomia ventralis*, 23 – pronotum L_3, 24 – abdominal tergite V, right side L_3, 25 – pronotum L_1, 26 – abdominal tergite V, right side L_1 (scales in mm).

length, antennomere IV about 0.6 as long as the other segments; antennomere I with 7–8 setae, 4 long setae on inner margin, antennomere II with 7–8 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2–3 distinct spines, setal group gMX with about 40 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3–4 spines apically, palpomere II with 1 seta below the middle.
THORAX. Pronotum (Fig. 23) with anterolateral angles produced, sharp; 12–15 long and 10–20 very short setae on each half, long setae in part flattened; no grooves or elevations distinct. Mesonotum with a multisetos posterior margin. Metanotum without a multisetos posterior margin.
ABDOMEN. Tergites I–IV with 4–5 long and 6–12 very short setae; tergite V (Fig. 24) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with a row of 4–5 setae; anterior part of tergite V with 10–14 long setae, lateral part with 4–5 long setae, posterior part with 10–14 bristles and 8–12 thin setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite with 4–5, the small with 1–2 setae. Posterior margin of tergite IX with 3 pairs of setae, the outer very long, the inner shorter and thicker. Pygopod with 8–14 strong setae dorsally and 16 on apical margin.

Instar II

The following character states are different from the third instar larva:
HEAD. Antennomeres I and II with 5–6 setae, antennomere I with 3 long setae on inner margin, galeomere I with 2 setae, palpifer with 4–5, gMX group with about 30 setae.
THORAX. Pronotum with 5–7 long and 10–12 short setae on each side.
ABDOMEN. Anterior part of tergite V with 4–5 long setae, lateral part with 2 setae, posterior part with 6–8 bristles. Median hooks with 2 bristles.

Instar I

The following character states are different from the second instar larva:
HEAD. Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer without setae, stipes with 1 spine basally, setal group gMX on stipes with about 10 setae, labial palpomere I ventroapically with 3 spines but without setae.
THORAX. Pronotum (Fig. 25) with 7 setae, most of them flattened. Posterior margin of mesonotum not multisetos, but with distinct more setae than on the rest of metanotum.
ABDOMEN. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 26) with 5 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 seta. Epipleuron and hypopleuron each with 1 large sclerite with 2–3 setae. Small sclerite not distinct. Pygopod with 6 long setae dorsally, 8 on apical margin.

Remarks

All examined species of the closely related genera *Odontocheila*, *Cenothyla* and *Pentacomia* are distinguished in larval instar III. However, at present it seems impossible to separate the larvae at the generic level.

Odontocheila cayennensis is distinguished from the rest of species by the reduced chaetotaxy of pronotum. *Pentacomia ventralis* and *P. egregria* have, contrary to the other species, more

than 5 setae on antennomeres I and II, and peculiar character states on the median hooks. *Pentacomia ventralis* has a slender median hook with 4–5 setae, and *P. egregria* a slender median hook with 1 seta basally and 1 seta in the apical half. The rest of the species have 2 bristles, usually near the middle on the median hooks. Moreover, *P egregria* has a conspicuously flattened and black seta on antennomere II. *Odontocheila chrysis* and *O. margineguttata* are distinguished by the dark head and pronotum from the remaining species with yellow-brown heads and pronotums (see remarks of *O. margineguttata*). *Odontocheila confusa* and *O. luridipes* have a few flattened setae on head and pronotum. *Odontocheila confusa* has slender median hooks with 2 bristles in the middle, while *O luridipes* stout median hooks with 2 bristles basally. Contrary to these species, *Cenothyla varians* and *Pentacomia lacordairei* lack flattened setae in third instar. For distinguishing both species see the discussion of *Cenothyla varians*.

Larvae of *P. ventralis* were collected on a small, dry clay area free of vegetation in the Terra Firme forest near Manaus. The larval holes are very short (only 4 cm in the third instar). The larvae are associated with those of *Brasiella argentata* Fabricius, 1801.

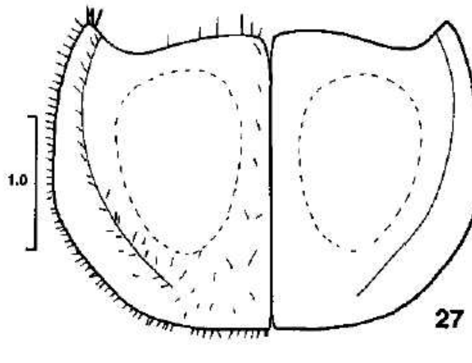
Pentacomia egregria was collected in inundation forests of the Solimões River near Manaus (Amorim et al. in press).

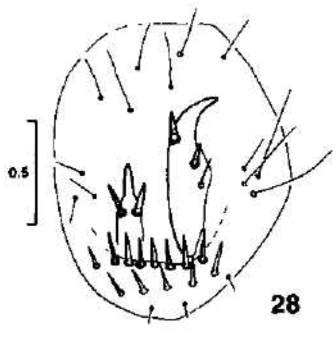
Cheilonycha chalybea (Dejean, 1825)
(Figs 27, 28)

Instar III

COLORATION. Head and pronotum brown, region near eyes darker, brown to black without or with slightly green lustre, rest of thoracal and abdominal sclerites light brown and little distinct, only tergites VIII and IX darker than previous, yellow-brown. Setae pale.

HEAD. Nasale produced, wide, anterior smooth, limited on outer side by two large teeth; coronal suture short but distinct, about as long as antennomere III wide; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomeres I and II distinct longer and wider than antennomeres III and IV; antennomeres I with 4 setae, 3 on inner margin, 1 ventrally, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral





Figs 27–28. *Cheilonycha chalybea*, 27 – pronotum L_3, 28 – abdominal tergite V, right side L_3 (scales in mm).

part of cardo triangular, inner margin of stipes with 2–3 distinct spines, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 5 setae and attaching the galea; galeomere I with 3 large, galeomere II with 5 setae; ventral double sclerite on prementum present, labial palpomere I with 3–4 setae and 3 spines apically, palpomere II with 1 seta basally. A part of the setae near eyes and on vertex ridge flattened.
THORAX. Pronotum (Fig. 27) covered with clay rests frequently. Anterolateral angles produced, sharp, with some flattened setae; disk with deep impressions; pronotum with a keel along lateral margin, the keel bearing a row of 16–20 setae; the rest of pronotum with 40–50 setae on each half.
ABDOMEN. Tergites I–IV with 4 long and a number of very short, pale and undistinct setae; tergites and sternites little sclerotized and undistinct; tergite V (Fig. 28) 3-segmented with 2 pairs of hooks; inner hooks stout with 1–2 stout bristles basally, median hooks stout and strongly arched with 2–3 strong bristles and 1–2 thin setae; anterior part of tergite V indistinct with 6–10 long setae, lateral part with 4–5 long setae, posterior part with 2 rows of 8–10 bristles. Hypopleuron and epipleuron like tergites not distinct, with 1 large (and 1 small?) sclerite. Tergites VIII and IX stronger sclerotized than previous, posterior margin of tergite IX with 2 pairs of long setae 1 pair of stout bristles in the middle. Pygopod with 16–20 setae dorsally and 16–22 bristles on apical margin.

Instar II
The following character states are different from the third instar larva:
HEAD. Galeomere I with 2 bristles, palpifer with 3 setae.
THORAX. Pronotum with 8–10 setae on the keel, and about 25 setae on the rest of pronotum.
ABDOMEN. Anterior part of tergite V with 4–5 long setae, lateral part with 2 setae, posterior part with 6–8 bristles. Median hooks with 2 bristles.

Remarks
One third instar specimen of *Cheilonycha auripennis* Lucas, 1857 was examined. It is distinguished from *C. chalybea* by having only 8 bristles on the posterior part of tergite V. It will require more material to determine if this character is of specific value.

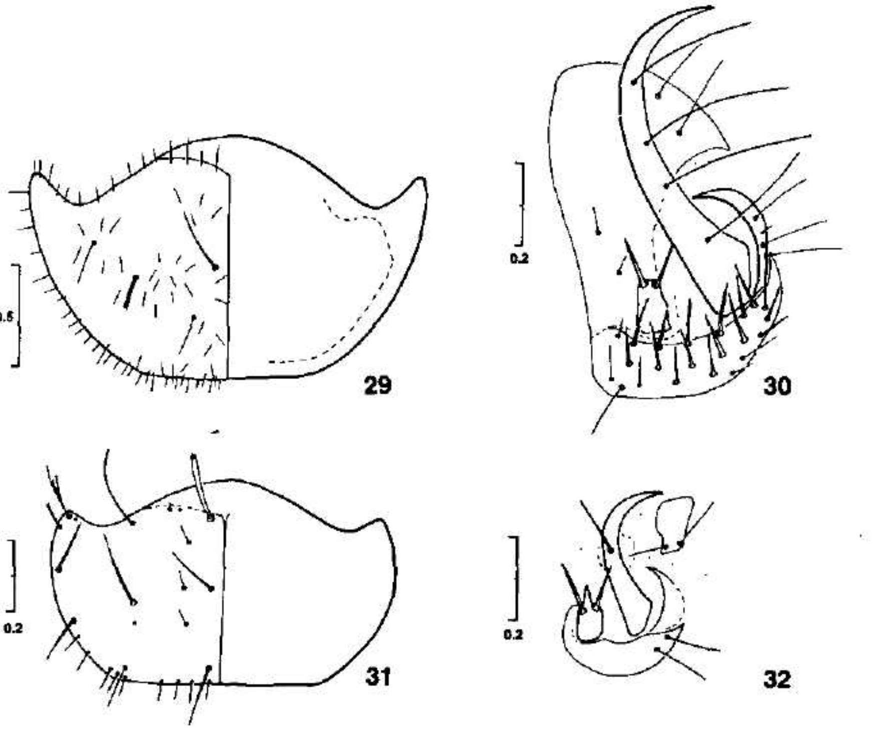
Wasmann (1895a, b) and Berg (1900) report about the hunting behaviour of *Cheilonycha* adults on termite hills, but did not find the larvae. The larvae described herein were collected on termite hills (probably of *Cornitermes* species). Their larval holes were close to the holes of luminescent larvae of Elateridae (Costa, pers. comm.).

Cylindera (_Plectographa_) _suturalis_ (Fabricius, 1798)
(Figs 29–32)

Instar III
COLORATION. Head and pronotum brown, with distinct metallic-green lustre; anterolateral angles of pronotum pale without green lustre, rest of sclerites brown without lustre. Setae pale yellow to pale brown.
HEAD. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae, setae on head capsule not flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 5–6 setae, 3 long setae on inner margin, antennomere II with 5–7 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral

part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with about 30 setae, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3–4 spines apically, palpomere II with 1 seta in the middle.
THORAX. Pronotum (Fig. 29) with anterolateral angles produced, sharp; 8–12 long setae on each *half*, setae not flattened; no grooves or elevations distinct.
ABDOMEN. Tergites I–IV with 5–6 long and 4–5 short setae; tergite V (Fig. 30) with 3 parts, lateral and posterior part attaching and much stronger sclerotized than the separate anterior part; anterior part of tergite V with 4–8 setae, lateral part with 3 setae, posterior part with 12–18 bristles and 4–8 thin setae; 2 pairs of hooks present; inner hooks reduced, very short with 2 short bristles, bristles distinctly longer than apical spike of inner hooks; median hooks very long and slender compared with those of previous species, strongly arched with 3–5 long setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite with 4–6, the small with 1 seta. Posterior margin of tergite IX with 3 pairs of setae. Pygopod with 16–22 setae of variable size dorsally and 14–16 on apical margin.

Instar II
The following character states are different from the third instar larva:
COLORATION. Pronotum not bicolored, like on head brown with green lustre without pale margin.



Figs 29–32. *Cylindera suturalis*, 29 – pronotum L_3, 30 – abdominal tergite V, right side L_3, 31 – pronotum L_1, 32 – abdominal tergite V, right side L_1 (scales in mm).

HEAD. Antennomeres I and II with 4–5 setae, galeomere I with 2 setae, palpifer with 4–5; labial palpomere I with 3 setae and 3 spines.
THORAX. Pronotum with 10 setae on each side (cf. Fig. 31).
Abdomen. Anterior part of tergite V with 2–3 setae, lateral part with 2 setae, posterior part with 10–12 bristles and 4–8 thin setae. Median hooks with 3 setae. Hypopleuron and epipleuron each with 3–4 setae on large and 1 seta on small sclerite. Pygopod with 12–14 setae dorsally and 12–14 setae on apical margin.

Instar I
The following character states are different from the second instar larva:
HEAD. Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer without setae, stipes with 1 spine basally, setal group gMX on stipes with about 15 setae, labial palpomere I ventroapically with 3 spines but without setae.
THORAX. Pronotum (Fig. 31) with 10 setae on each side, anterior margin in the middle with a strong and flattened seta.
ABDOMEN. Tergite I with 3 long and 5 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 3 short setae. Tergite V (Fig. 32) with 2 setae on anterior part and 1–2 setae on lateral part, setae lacking on posterior part. Inner hooks more distinct, apical spine half as long as the setae of the hooks, median hooks with 1 seta. Epipleuron and hypopleuron each with 2 setae on the large sclerite and without setae on the small sclerite. Tergite IX with 2 pairs of setae on apical margin. Pygopod with 6 long setae dorsally, 8 on apical margin.

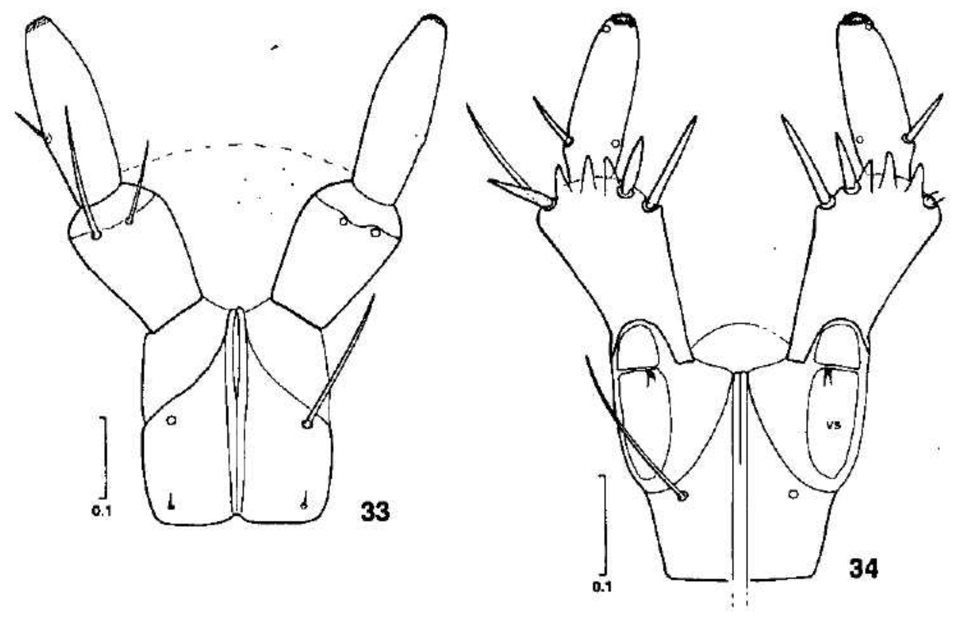


Fig. 33. *Amara sepulcralis*, labium, ventral aspect, L_3, 34 – *Cenothyla varians*, labium, ventral aspect L_3 (vs–ventral double sclerite) (scales in mm).

Remarks

The larvae of *Brasiella argentata* and *Cylindera* (*Cylindera*) *morio* (Klug, 1834) are very similar to the described larva of *C. suturalis*. *Brasiella argentata* is distinguished by the measurements (see Table 1), 2 setae more on antennomeres I and II in second and third instar, and the less sclerotized anterior part of tergite V. The anterior part of tergite V is practically 2-segmented in *B. argentata*, and the median hooks always have 3 setae in second and third instar. *Cylindera suturalis* is more similar to *B. argentata* than to *C. morio*, even though the former two species are placed in separate genera. Contrary to *C. suturalis*, the third instar of *C. morio* has 12–16 setae on abdominal tergites I–IV, the lateral and posterior parts of tergite V are fused completely, and all parts of tergite V are well sclerotized, with the anterior part having 18–22 setae, and the posterolateral part 16–22 spines and 16–22 thinner setae.

Larvae of *C. suturalis* were collected on sandy beaches of the Solimoes River near Manaus.

Larvae of *C. morio* were collected in areas with sparse vegetation in the Terra Firme forest near Manaus, where the clay soil is covered with a 10 cm deep layer of sand. The larval holes of the third instar are about 15 cm deep and perpendicular.

Larvae of *B. argentata* were collected on a small, dry clay area free of vegetation in the Terra Firme forest near Manaus. The larval holes are very short (only 4 cm in the third instar), and the larvae are associated with those of *Pentacomia ventralis*.

Key to the second and third instar larvae of Brazilian genera of Cicindelidae

REMARKS. Larval instars can be distinguished by the number of setae on galeomere I: instar III with 3 setae (4 in Megacephalini), instar II with 2 setae (3 in Megacephalini), instar I with 1 seta on galeomere I. First instar larvae of most genera are not distinguishable.

1 (2) Head and prontum slender, not wider than abdomen. Abdominal segment V only slightly enlarged, tergite V with 3 pairs of hooks, median hooks stout, pressed to the body. Legs short, tarsus reduced, claws not distinctly separate from tarsus, larva therefore unable to run on a plain surface. Larval holes in branches of rotten wood ..... (Ctenostomini) *Ctenostoma* Klug

2 (1) Head and pronotum wide, distinctly wider than abdomen. Abdominal segment V strongly enlarged in dorsal direction, building a „hump". Tergite V with 2 or 3 pairs of hooks, median hooks slender and not pressed to the body. Legs long, tarsus not reduced with distinctly separate claws. Larval holes always in the soil ..... (Megacephalini & Cicindelini)

3 (6) Gular suture Y-shaped. Ventral double sclerite on prementum lacking (Fig. 33). Median hooks of abdominal tergite V straight or only slightly arched, often spine-shaped on the top (Fig. 2). Antennomeres I and II very thick, 3–5 times wider than antennomere III ..... (Megacephalini)

4 (5) Pronotum unicolored, dark, in part with metallic lustre or covered with numerous white and flattened setae. Maxillary palpomere I with strong spine on outer side ..... *Megacephala* Latreille

5 (4) Pronotum bicolored, medial and anterior parts dark brown with bronze lustre, lateral and posterior margin pearl-white. Setae on pronton not pale or flattened. Spine on outer side of maxillary palpomere I lacking ..... *Aniara* Hope

6 (3) Gular suture T-shaped. Ventral double sclerite on prementum present (Fig. 34). Median hooks of abdominal tergite V slender, arched (Figs 10, 14, 16, 20, 24, 28, 30). Antennomeres I and II not obviously wide, less than 2 times wider than antennomere III ..... (Cicindelini)

7 (10) Abdominal tergite V with 3 pairs of hooks, coronal suture distinct and only slightly shorter than last antennomere, antennomeres I–III of about equal length. ..... (Iresina)

8 (9) First maxillary palpomere with a small spine apically; antennomeres I and II with 7–8 setae; median hooks with 4–6 (rarely 3) stout setae; posterior margin of sternite IX with 8–10 long setae. ..... *Oxycheila* Dejean

9 (8) First maxillary palpomere without spine; antennomeres I and II with 4–5 setae; median hooks with not more than 3 stout setae, posterior margin of sternite IX with 6–7 long setae. ..... *Euprosopus* Dejean

10 (7) Abdominal tergite V with 2 pairs of hooks (Figs 10, 14, 24, 28, 30), coronal suture very short or absent; antennomeres I and II slightly longer and about 2 times wider than antennomere III ..... (Prothymina & Cicindelina)

11 (14) All setae on median hooks are stout bristles; apical spine of inner hooks comparable long (Figs 10, 14, 16, 20, 24, 28) Labial palpomere II with 1 seta in basal half of the segment . ... (Prothymina)
12 (13) Pronotum with more than 40 setae per half and a setiferous keel posterolateral (Fig 27). Abdominal tergites slightly sclerotized, undistinct Larval holes on termite hills in the Southern part of Brazil. . . . *Cheilonycha* Lacordaire
13 (12) Pronotum with less than 30 setae per half and without setiferous keel posterolateral (Figs 9, 15, 23) Abdominal tergites distinct . ... *Odontocheila* Castelnau, *Cenothyla* Rivalier and *Pentacomia* Bates*
14 (11) Most or all setae of median hooks thin and long; apical spine of inner hooks usually shorter than lateral setae (Fig 30). Labial palpomere II with 1 seta near the middle of the segment. .... (*Cicindelina*) *Cylindera* Westwood, *Brasiella* Rivalier*

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* Larvae of these genera are not to distinguish doubtless at generic level, see remarks in the description.

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BOOK REVIEW

MEHLHORN H , DUWEL D & RAETHER W **Diagnose und Therapie der Parasitosen von Haus-, Nutz- und Heimtieren 2nd expanded and revised edition** Stuttgart-Jena-New York Gustav Fischer Verlag, 1993, XIII+529 pp Format 170×240 mm hardcover, price DM 128 00, ISBN 3–437–30706–1

The first author is professor at the Chair of special Zoology and Parasitology in Bochum The other two authors are renowned investigators in the pharmaceutical research of the Hoechst Company in Frankfurt on the Main As emphasized in the preface, the first edition aroused a great interest Moreover, Spanish and English translations appeared in print The names of parasitic diseases are presented here according to the standardized nomenclature of animal parasitic diseases (SNOAPAD) published (*Vet Parasit*, 29 1988, 299–326) by the expert committee, appointed by the Executive Committee of the World Association for the Advancement of Veterinary Parasitology The volume consists of 11 chapters which are subdivided using the decimal system

Chapter 1 is intended to give an introduction to laboratory methods for identification of parasites Macroscopical methods cover the preparation and staining of flukes, tapeworms and roundworms Microscopical methods deal with examinations of blood, saliva, lymph, urine, mucous membranes and tissues, further on with examinations of ectoparasites, soil samples and *feed-stuffs, antibody tests, with animal experiments (identification in vivo) and sending specimens to a reference laboratory* Among microscopical methods looked at are the anal swabs, wet mounts, concentration techniques, cultivation, stained films, and histological techniques Chemicals and solutions for the preparation of reagents are also presented here In the chapters 2 to 11 listed here are the parasites of dogs and cats, of swine, solid-hoofed animals, ruminants, hare, rabbit and laboratory animals, birds, hedgehog, fishes, reptiles and amphibians and finally of honey-bee In particular chapters described are the parasite life torms, occuring in faeces or in the intestine, in blood, in the saliva, in the urine and in various organs - in the liver, spleen, in the muscle tissue, in the stomach, in brain and eyes, in the trachea, in the genital and on the body surface in the skin, in hair and feathers In each chapter keys for determination of parasites are situated

Parasite species are described in detail in their most frequent host or in place of their most probable findings In particular parasitic diseases due to protozoans, helminths or arthropods the geographical distribution in Europe, the morphological and biological characteristics of the pathogen and clinical symptoms are listed Diagnosis includes references to the causative life form of particular parasites and to the diagnostic method Moreover, listed are the transmission ways, the prophylaxis, prepatent and patent periods and specific treatment

The volume is extensively augmented by 206 high-quality line drawings, and light, transmission or scanning electronc photomicrographs which characterize the host or parasite animals as a whole or in detail, dissected organs and histological structures Many of them constitute full-page plates composed of several pictures In 17 tabular reviews there are instuctions for the therapy This book presents a practical laboratory manual It is primarily designed for veterinary parasitologists Moreover, it can be of great value for biologists and medical professionals interested in parasitic diseases and zoonoses

Jindřich Jíra

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Larvae of genera *Eurythyrea* and *Phaenops* from Central Europe (Coleoptera: Buprestidae)

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Abstract Adult larvae of *Eurythyrea austriaca* Linnaeus, 1767 and *Phaenops knoteki hellenica* Obenberger, 1944 are described and illustrated Keys to larvae of both genera from Central Europe are given

Larvae, descriptions, morphology, keys, Palaearctic region

Although more than 50% of buprestid larvae from Central Europe have been described up to now, only a few papers have delt with particular genera giving keys allowing a determination of larvae. The first and very poor description of larva of *Eurythyrea* Lacordaire, 1835 was published by Schiødte (1870) for the larva of *E. micans* (Fabricius, 1792) (= *E. marginata* Olivier, 1790). Larvae of *E. quercus* (Herbst, 1790) and *E. aurata* (Pallas, 1776) were perfectly described by Volkovitsh (1975) and larvae of the whole genus were characterized by Schaefer (1947) and Bílý (1994). Larva of the last species from Central Europe, *E. austriaca*, has remained undescribed so far and it is described here.

The first descriptions of larvae of the genus *Phaenops* Lacordaire, 1857 were published by Perris (1854, 1877) and subsequently by Richter (1949) (all for *P cyanea* Fabricius, 1775). The descriptions are quite insufficient and the first full description of *Phaenops*-larva was published by Schaefer (1937) who described larva of *P. formaneki lavagnei* Théry, 1942. The next larval descriptions were published by Alexeev (1964) (*P. cyanea* and *P. guttulata* Gebler, 1830) and the larval characteristics of the genus was published by Bílý (1994). A larva of the last species from Central Europe, *P. knoteki* Reitter, 1898, is described in the present paper (*P. knoteki hellenica*)

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METHODS

Larvae were collected in the field to the Khale liquid and transferred to 75% alcohol in laboratory After having studied external structures the larvae were dissected and mouth parts, antennae, spiracles and proventriculus were mounted separately in Swan liquid for microscopical studies

All material is deposited in the collection of the National Museum, Praha

The morphological terminology is taken from the papers of Volkovitsh (1979), Bílý (1994) and Volkovitsh & Hawkeswood (1987, 1993)

Eurythyrea austriaca (Linnaeus, 1767) – adult larva (Figs 1–19)

MATERIAL STUDIED Slovakia, Nízké Tatry Mts , vii.1972, F. Navrátil leg , 1 spec of adult larva from *Abies alba*, the same data, 1 spec of prepupa.

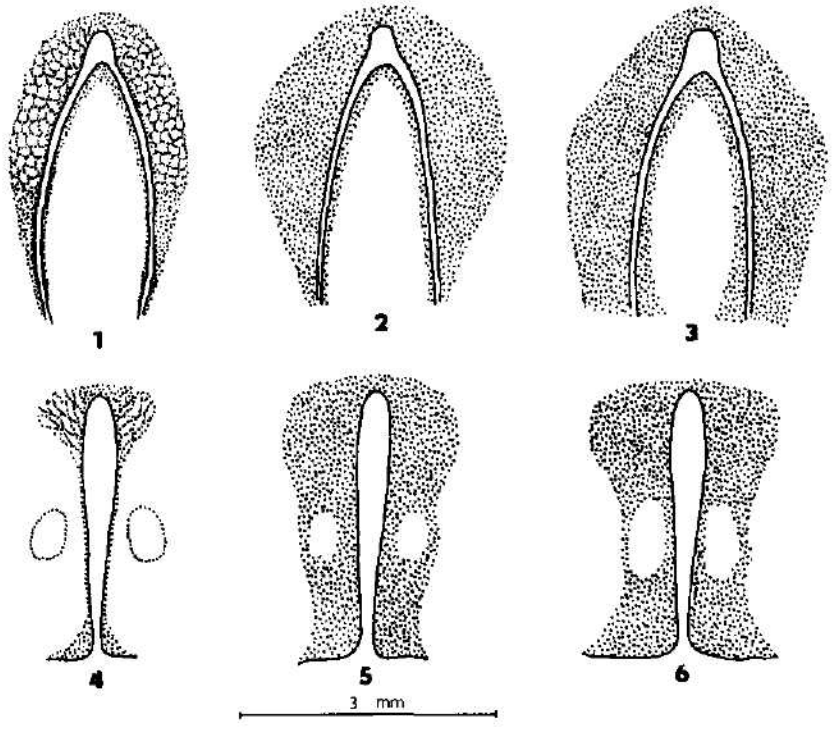
Length of the last instar: 31.0 mm; width of prothorax: 5.9 mm.

Larva is of the usual buprestoid type, whitish with enlarged prothorax, corresponding to the second morpho-ecological type of Buprestid-larvae (Bílý 1982, 1984).

HEAD AND MOUTHPARTS. Epistome (Fig. 7) brown, about 10 times as wide as long in the middle, its anterior margin deeply and widely incurved between mandibular condyles which are relatively small with obtuse antero-lateral projections; posterior margin of epistome straight, latero-posterior corners sharp-angled; middle part of epistome with two groups of epistomal sensillae (Fig. 7), each group consisting of one campaniform and two short trichoid sensillae. Clypeus narrow, membranous, nearly straight anteriorly.

Labrum (Fig. 17) slightly transverse, its anterior margin nearly straight, antero-lateral corners obtuse and lateral margins deeply incurved; palantinae sclerites with both branches well-sclerotized; each medial branch bears one campaniform and three trichoid sensillae, each lateral branch bears two trichoid sensillae; there are also two campaniform sensillae situated between lateral and medial branches of palantinae sclerites; ventral surface of labrum (epipharynx) with two longitudinal bands of microspinulae.

Antennae (Fig. 16) two-segmented, situated in the latero-posterior incisure of epistome; first segment broadly cylindrical, slightly bent, not invaginated into basal membrane, about 1.5 times as long as wide; apex of the first segment with a ring of microspinulae surrounding the basis of the second segment and with a large campaniform sensilla on external side; second antennal



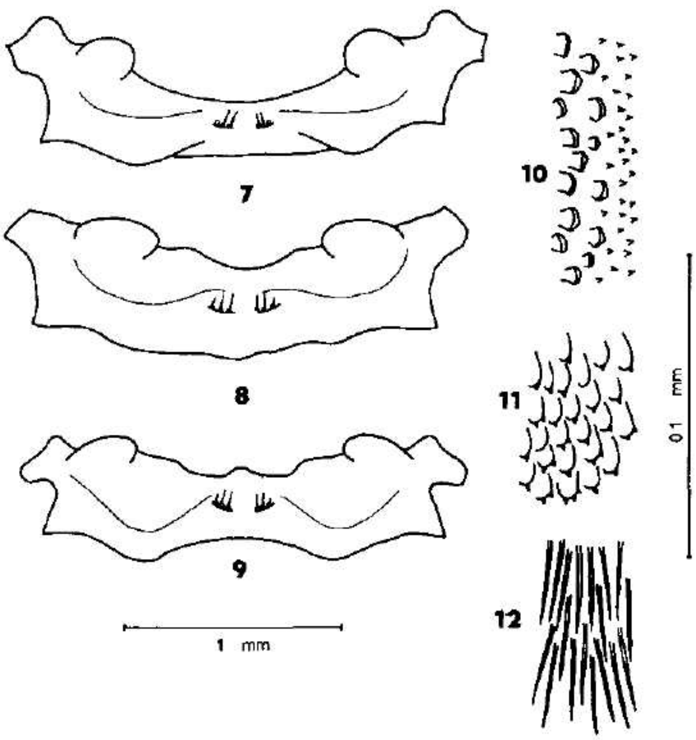
Figs 1–6. 1–3: pronotal plates. 1 – *Eurythyrea austriaca*; 2 – *E. quercus*; 3 – *E. aurata*. 4 – 6: prosternal plates. 4 – *E. austriaca*; 5 – *E. quercus*; 6 – *E. aurata*.

segment 1 5 times as long as wide, slightly enlarged apically with a deep, apical cavity, apex of the 2nd segment with a ring of very fine microspinulae surrounding the apical cavity and with long, trichoid seta, apical cavity contains a sensory appendage, one small basiconic sensilla and two palmate sensillae (Fig 16)

Mandibles (Fig 13) strongly sclerotized, almost black with nearly straight outer margin, apex of mandibles with two obtuse teeth, cutting edge with four small and obtuse teeth

Labiomaxillary complex Maxillae cardo membranous with small, well-sclerotized sclerite bearing two long trichoid setae and two campaniform setae, stipes (Fig 15) with less sclerotized inner sclerite and strongly sclerotized, prolonged outer sclerite which bears one campaniform sensilla and one apical seta, next two setae are situated at the base of mala, mala subcylindrical, about 1 5 times as long as wide bearing 7 long and thick setae and several microspinulae at its apex, maxillary palpus two-segmented, first segment short, nearly triangular, bearing long, apical, outer seta, second segment of maxillary palpus conical (Fig 15) with one curved, inner, seta and one campaniform, outer sensilla, apex of segment with several peg-like sensillae and microspinulae

Labium (Fig 14) slightly longer than wide with deep medial incission and subparallel lateral margins, corner sclerites of labium feebly sclerotized, prolonged and enlarged anteriorly, enlarged anterior part bearing one long seta and 3 campaniform sensillae, anterior margin and



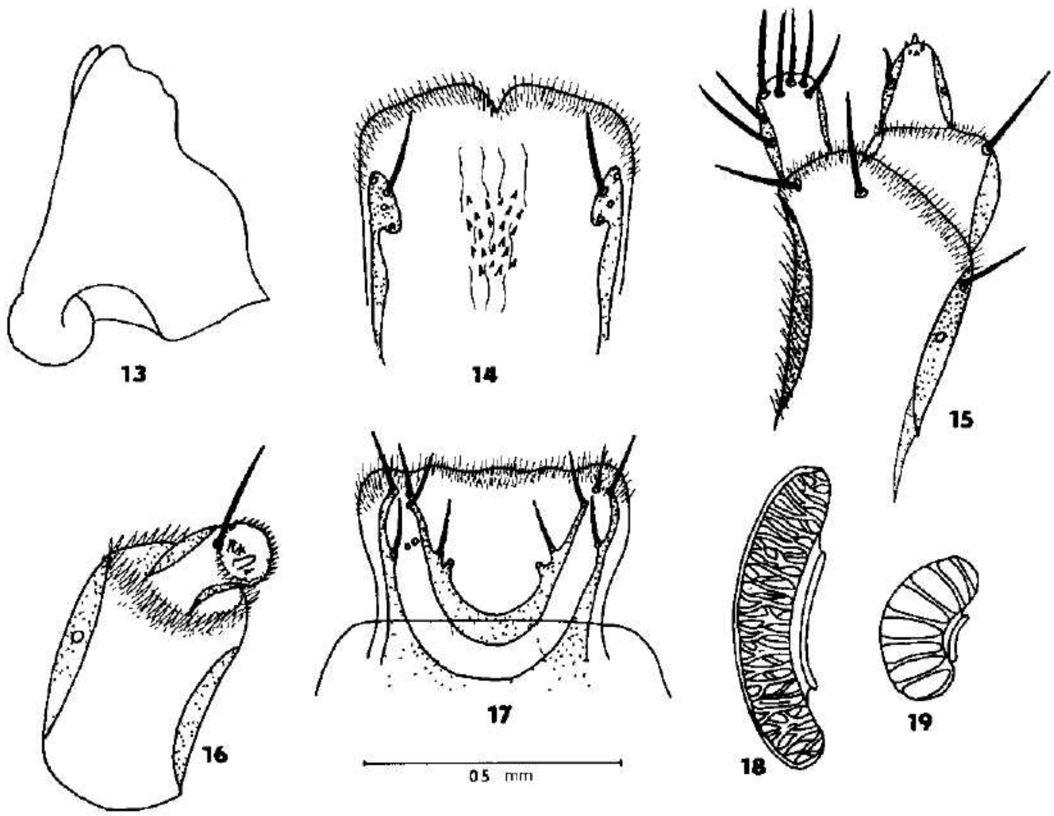
Figs 7–12 7 9 epistome 7 – *Eurythyrea austriaca*, 8 *E quercus*, 9 *E aurata* 10 asperities and microspinulae along the prosternal groove of *E austriaca*, 11 – inner structure of proventriculus of *E austriaca*, 12 the same, spines near pylorus

antero-lateral, obtuse angles of labrum bearing short but dense hairs and microsetae; both internal and external surfaces of labium with a group of microspinulae.

THORAX. Pronotal plate (Fig. 1) with well-developed V-shaped groove, its branches somewhat convergent posteriorly; grooves are surrounded by the field of fine, brown asperities forming net-like structure; space between both branches of V-shaped groove covered with microspinulae, asperities developed only along the grooves (Fig. 10). Prosternal plate (Fig. 4) with well-developed medial groove which is somewhat enlarged anteriorly; surface of plate covered with microspinulae except from two oval and glabrous depressions; brown asperities developed only around apical part of medial groove and at its basis; medial part of groove margined only by one row of asperities.

Rest of prothorax, mesothorax and metathorax covered with dense microspinulae and short and very sparse hairs.

SPIRACLES. Mesothoracic spiracles (Fig. 18) large, prolonged, about 6 times as long as wide with feebly sclerotized peritreme and with dense trabeculae which are densely branched; abdominal



Figs 13–19 Adult larva of *Eurythyrea austriaca* 13 – left mandible, 14 – labium; 15 – right maxilla; 16 – antenna; 17 – labrum; 18 – mesothoracic spiracle; 19 – abdominal spiracle.

spiracles (Fig. 19) much smaller, reniform, about 2.5 times as long as wide with simple, not branched trabeculae.

PROVENTRICULUS. Inner surface of proventriculus covered with membranous tubercles bearing small, sclerotized spines (Fig. 11); near pylorus there is a prolonged field of long, sharp and feebly sclerotized bristles (Fig. 12).

ABDOMINAL SEGMENTS. Shortly cylindrical, somewhat longer than wide, covered with microspinulae and sparse, short hairs; anal segment conical without spiracles; abdominal spiracles situated in anterior part of lateral depressions.

PREPUPA. Pro-, meso- and metasternum of prepupa with rudiments of two-segmented appendages, abdominal segments of prepupa slightly wider than long.

Key to *Eurythyrea* larvae from Central Europe

1 (2) Asperities surrounding pronotal and prosternal grooves forming net-like structure (Figs 1, 2); epistome widely incurved between mandibular condyles and nearly straight on posterior margin (Fig 7), host plant. *Abies alba* .... *E. austriaca* (L.)

2 (1) Asperities surrounding pronotal and prosternal grooves not forming net-like structure (Figs 2, 3, 5, 6); epistome of a different shape (Figs 8, 9)

3 (4) Epistome with irregularly rounded posterior margin (Fig. 8); mesothoracic spiracles narrow, about 6 times as long as wide, pronotal plate Fig 2, prosternal plate Fig. 5; host plant. *Quercus* spp , *Castanea sativa* .... *E quercus* (Herbst)

4 (3) Epistome with deeply incurved posterior margin (Fig 9); mesothoracic spiracles shorter, only 3 times as long as wide, pronotal plate Fig 3, prosternal plate Fig 6, host plant *Populus* spp .... *E aurata* (Pallas)

Phaenops knoteki hellenica Obenberger, 1944 – adult larva (Figs 20–35)

MATERIAL STUDIED Greece, Peloponesos, Taygetos Mts., vi.1981, S.Bílý leg , ex *Abies cephalonica*, 31 spec of adult larvae

Length of the last instar: 23.0–25.0 mm; width of prothorax: 4.0–4.5 mm.

Larva is of the usual buprestoid type, whitish or cream-coloured, corresponding to the second morpho-ecological type of Buprestid-larvae (Bílý 1982, 1994).

HEAD AND MOUTHPARTS. Epistome (Fig. 26) dark brown, about 4 times as wide as long in the middle, anterior margin widely and shallowly incurved between mandibular condyles which are large and spherical, with obtuse antero-lateral projections; posterior margin nearly straight with sharp, almost rectangular latero-posterior angles; middle part of epistome with two groups of epistomal sensillae, each group consisting of one campaniform and two short, trichoid sensillae (Fig. 26). Clypeus membranous with straight anterior margin (Fig. 27).

Labrum (Fig. 27) slightly transverse, its anterior margin feebly bisinuous, covered with nearly triangular field of fine hairs and microsetae; lateral margins of labrum converging posteriorly, slightly incurved; palantinae sclerites prolonged, their inner branches somewhat less sclerotized than outer ones; each inner branch bears one campaniform sensilla and one bristle apically and four campaniform sensillae at the middle; outer branches bear one apical bristle and one short, trichoid sensilla at the base; between inner branches there is one pair of short, stout trichoid sensillae; antero-lateral corners of labrum with two bristles and several trichoid sensillae; ventral side of labrum (epipharynx) with two longitudinal bands of microspinulae.

Antennae (Fig. 29) two-segmented, situated in the latero-posterior incisure of epistome; first segment somewhat longer than wide and enlarged anteriorly, bearing one large campaniform sensilla on outer margin; apex of the first segment with a shallow cavity which is surrounded by a ring of fine microspinulae; the second segment about 1.5 times as long as wide, distinctly

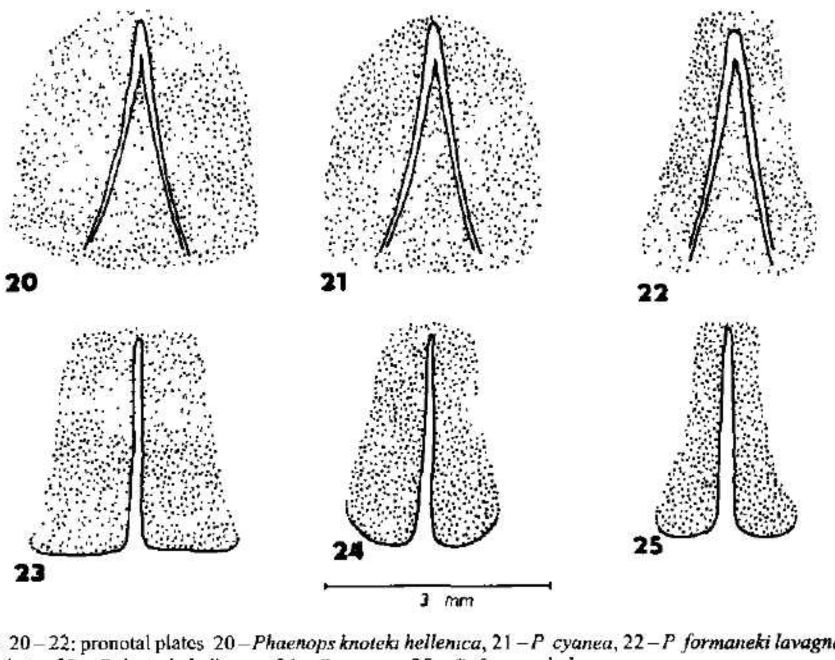
enlarged apically with deep apical cavity which is surrounded by a ring of microspinulae; anterior margin of the second segment with a long bristle near apex; apical cavity of the second segment contains a sensory appendage, one basiconic sensilla and two palmate sensillae at the bottom.

Mandibles (Fig. 28) black, strongly sclerotized, nearly triangular with slightly arched outer margin; both apical teeth rather obtuse, cutting edge without distinct teeth only with small, obtuse tubercles.

Labiomaxillary complex. Maxillae: cardo membranous with small, oval sclerite bearing two trichoid and one campaniform sensillae; stipes (Fig. 29) somewhat longer than wide and enlarged apically with an apical ring of fine hairs and microspines; outer sclerite with a large campaniform sensilla, inner sclerite with long and thick apical seta; inner margin of stipes with a field of fine bristles and hairs; mala 1.5 times as long as wide, enlarged apically, with 6 long and thick bristles and several apical microspinulae.

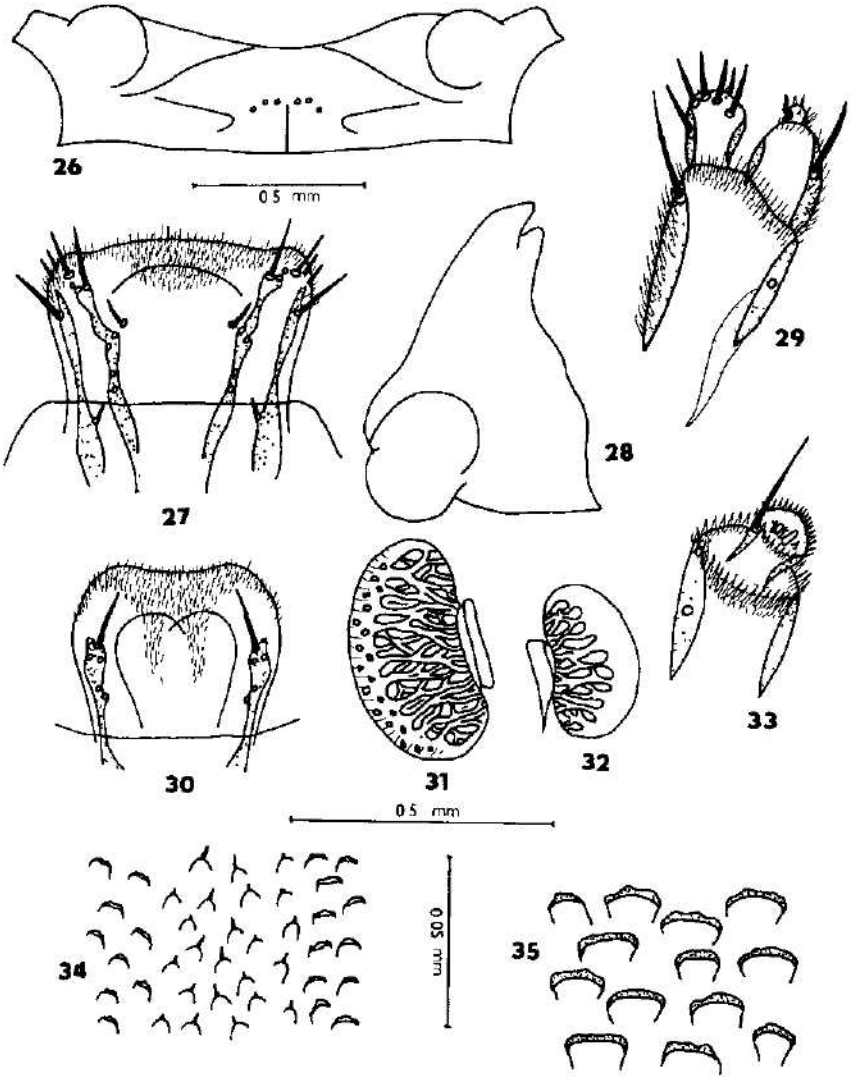
Maxillary palpus (Fig. 29) two-segmented, the first segment subcylindrical bearing long outer seta and a field of fine hairs on outer margin; the second segment small, conical with short and thick curved seta on inner margin; apex of the second segment with several peg-like sensillae and microspinulae (Fig. 29).

Labium (Fig. 30) membranous, nearly subcordiform with widely rounded antero-lateral corners; corner sclerites of labium slender, feebly sclerotized, somewhat enlarged apically; apical (enlarged) parts of these sclerites bearing three campaniform sensillae and one long, trichoid sensilla; middle part of sclerites with two small campaniform sensillae; anterior margin and antero-lateral corners of labium covered with fine hairs and microsetae, both internal and external surfaces of labium with fields of microspinulae.



Figs 20–25. 20–22: pronotal plates. 20 – *Phaenops knoteki hellenica*, 21 – *P. cyanea*, 22 – *P. formaneki lavagnei*. 23–25: prosternal plates. 23 – *P. knoteki hellenica*; 24 – *P. cyanea*, 25 – *P. formaneki lavagnei*

THORAX. Pronotal plate (Fig. 20) with its lateral sides slightly diverging posteriorly, posterior margin arched; V-shaped groove well-developed, its branches feebly bent outwards; prosternal plate (Fig. 23) bell-shaped with straight posterior margin, medial groove well-developed; both prosternal and pronotal plates covered with brown, well-sclerotized, transverse asperities (Fig. 35). Rest of thorax covered with dense, fine microspinulae and very sparse, short hairs.



Figs 26–35. Adult larva of *Phaenops knoteki hellenica*. 26 – epistome; 27 – labrum, 28 – left mandible; 29 – right maxilla; 30 – labium, 31 – mesothoracic spiracle; 32 – abdominal spiracle; 33 – antenna, 34 – inner structure of proventriculus; 35 – asperities of pronotal plate.

SPIRACLES. Mesothoracic spiracles (Fig. 31) broadly reniform, about twice as long as wide with dense, branched trabeculae; peritreme only feebly sclerotized; abdominal spiracles (Fig. 32) of the same type and shape but smaller.
PROVENTRICULUS. Inner wall of proventriculus covered with dense membranous tubercles bearing short, sclerotized spinulae and laminae (Fig. 34).
ABDOMINAL SEGMENTS. Shortly subcylindrical with dorsolateral depressions which bear abdominal spiracles in their anterior third.

Key to *Phaenops* larvae from Central Europe

1 (2) Pronotal plate narrow, its lateral sides concave (Fig. 22); prosternal plate nearly parallel-sided in anterior half (Fig 25), host plant *Pinus* spp . . . . *P formaneki lavagnei* Thery
2 (1) Pronotal plate wide, its lateral sides convex or nearly straight (Figs 20, 21); prosternal plate wider, bell-shaped (Fig 23) or regularly enlarged posteriorly (Fig. 24)
3(4) Pronotal plate very wide, its lateral sides nearly straight (Fig 20); prosternal plate bell-shaped with straight posterior margin (Fig 23), host plant: *Abies alba, A cephalonica* . . . . . . *P. knoteki hellenica* Obenberger
4 (3) Pronotal plate narrower, its lateral sides convex (Fig. 21), prosternal plate narrower, nearly pear-shaped, its posterior margin convex (Fig 24), host plant *Pinus* spp . . . . *P cyanea* (Fabricius)

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Revision, reclassification and larval morphology of the genus *Paratassa* (Coleoptera: Buprestidae: Paratassini tribus n.)

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Abstract. The genus *Paratassa* Marseul, 1882 is transferred from Bubastini to Paratassini tribus n. Eight new species are described and illustrated: *P. occidentalis* sp. n. and *P. medioatlassica* sp. n. from Morocco, *P. aurulenta* sp. n. and *P. meridionalis* sp. n. from Algeria, *P. tunesiaca* sp. n. from Tunis, *P. aegyptiaca* sp. n. from Egypt, *P. acuminata* sp. n. from Israel, *P. arabica* sp. n. from Saudi Arabia and *P. orientalis* sp. n. from Iran. Larva of *P. coraebiformis* (Fairmaire, 1875) is described and all species are keyed.

Taxonomy, new species, reclassification, biology, larval morphology, key, Palaearctic region

The present study was initiated by the discovery of two new species of *Paratassa* in Morocco and the larva of *P. coraebiformis* in Algeria. Having studied both male and female genitalia, we have decided to split this previously monotypic genus into ten species. Moreover, after having studied the larval morphology of *P. coraebiformis* and the antennae of *Paratassa* and related genera, we have decided to remove this genus from its traditional placement in the tribe Bubastini and place it in a new tribe, Paratassini, described below.

MATERIAL AND METHODS

The following abbreviations are used in the text. ISNB – Institut Royal des Sciences naturelles, Bruxelles, MCSN – Museo Civico di Storia Naturale, Genoa, MNHN – Muséum national d'Histoire naturelle, Paris, NMPC – National Museum, Prague and ZMAS – Zoological Institute, Academy of Sciences of Russia, St Petersburg.

All species of *Paratassa* are morphologically very similar each other so only one species (*P. coraebiformis*) is described in detail. The descriptions of new species are shortened in the form of differential diagnoses not to repeat many times the same morphological features.

For the deffinition of the surface structures of the adults we used the terminology of Harris (1979).

RESULTS

The systematic position of *Paratassa*

The type species of *Paratassa* Marseul, 1882, *P. coraebiformis* (Fairmaire, 1875), from „North Africa", was originally described in the genus *Sphenoptera* Solier, 1833. Later, Marseul (1882) separated it as a distinct genus, which has remained monotypic. Marseul pointed out that the structure of the clypeus, pronotum and antennal depressions as the basic diagnostic features. Kerremans (1903) positioned *Paratassa* into the group Buprestites of the tribe Buprestini between *Aristosoma* Thomson, 1879 and *Philanthaxia* Deyrolle, 1864. In the generic key from that work, Kerremans placed *Paratassa* adjacent to *Bubastes* Laporte & Gory, 1836 and *Euryspilus* Lacordaire, 1857 because of the similarity in the pronotal shape. Based on characters such as the

shape of body and prothorax, pronotal sculpture, disposition of antennal sensory pits, structure of tarsal claws, elytral apices and scutellum, Obenberger (1920) placed *Paratassa* together with the Australian genera *Bubastes, Euryspilus, Neraldus* Thery, 1910 (= *Bubastes*) and *Neurybia* Thery, 1910 (= *Euryspilus*) in the new tribe Bubastini *Paratassa* therewith was contrasted with the Australian genera by having the scutellum triangular and pointed apically, posterior pronotal corners not projecting outward, and the antennae broadened from the 4th antennomere, while the Australian genera have the antennae broadened from either the 5th or 6th antenomeres Later on additional Australian genera of Bubastini were described *Strandiola* Obenberger, 1920, *Notobubastes* Carter, 1924 and *Eububastes* Obenberger, 1928 The genus *Castelnaudina* Obenberger, 1924 (= *Castelnaudia* Obenberger, 1924 (= *Castelnaudia* Obenberger, 1923, name praeocc , = *Neobubastes* Blackburn, 1892) was originally placed in this group but was later transferred to the Buprestini by Obenberger (1930) Holynski (1988) regarded *Notobubastes* as a subgenus of *Psiloptera* Solier, 1833 (Psilopterini)

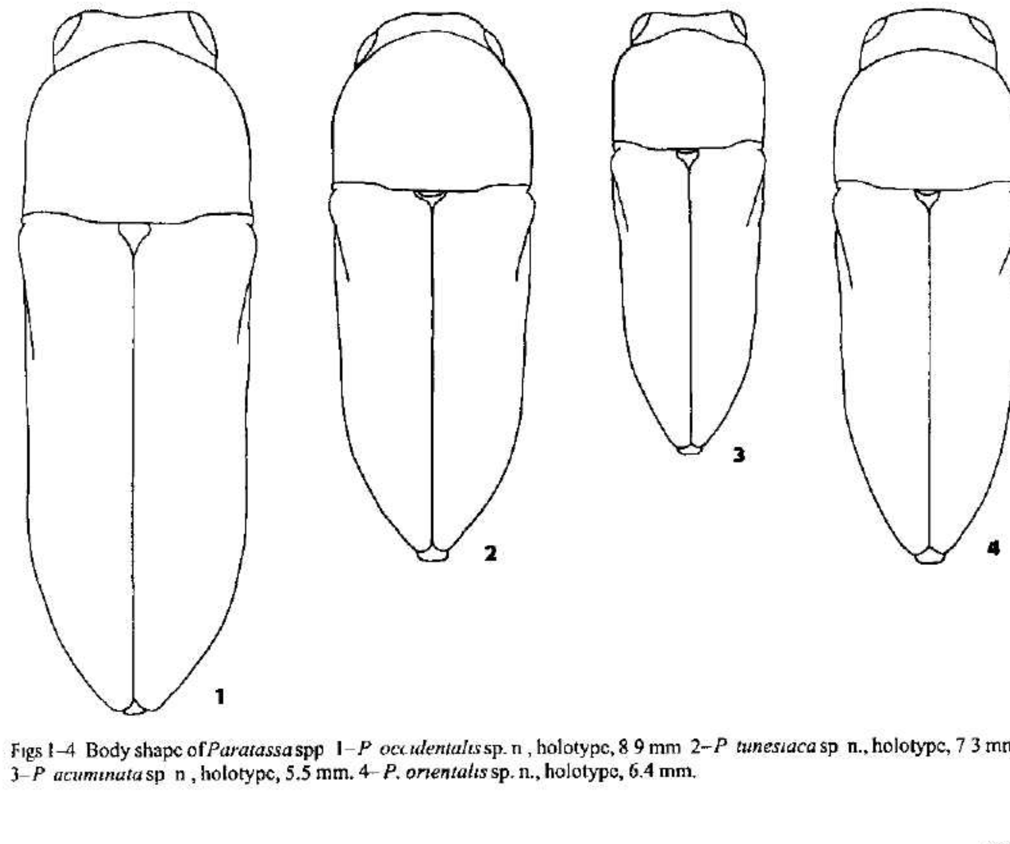
The integration of Australian and Palaearctic genera within Bubastini has been followed by all subsequent authors (e g Obenberger 1930, Bellamy 1985) Moreover Holynski (1988) regarded Bubastini as a subtribe of Anthaxiini, and then (Holynski 1993) combined it with the tribe (subtribe according to Holynski) Thomassettiini Bellamy,1987 (= Philanthaxiina Holynski,1988), and even attributing Nearctic genus *Chrysophana* LeConte,1860 (Polycestini Polycestinae) to its composition which does not correspond with our results

Scanning electron microscope study of buprestid antennae has cast some doubts upon the monophyly of Bubastini The examination of the larvae of Australian genera *Neocuris* Fairmaire, 1877 (Volkovitsh & Hawkeswood 1987), *Anilara* Thomson, 1879 (Volkovitsh & Hawkeswood 1993) and *Melobasis* Laporte & Gory, 1837 (Volkovitsh & Hawkeswood 1995), which have been traditionally attributed to Anthaxiini and Melanophilini, has shown that these genera, at least regarding to larval characters, were not closely related to Holarctic, Ethiopian and Oriental representatives of indicated tribes From our viewpoint the external resemblance of adult beetles of Australian and non Australian genera resulted from parallel evolution and convergence of autochthonous Australian groups (in much the same way as it occurs in the mammals), although there are other than autochthonous taxa in Australian fauna – as a rule they belong to wide distributed genera (*Strigoptera* Dejean 1837, *Chrysodema* Laporte & Gory 1835, *Chrysobothris* Eschscholtz 1829, *Agrilus* Curtis, 1825, etc) with mainly Oriental relations The autochthonous origin of the majority of Australian genera is confirmed with palaeogeographic and palaeoclimatic data which point out to the fact of the long–term isolation of Australian biota

Unfortunately, the larvae of Australian Bubastini remain unknown up to date, so our opinion on the polyphyly of this tribe is based mainly on the results of comparative morphological study of antennal sensory formations Apart from *Paratassa* the antennae of *Neobubastes australasiae* (Obenberger, 1922), *Eububastes nickerli* Obenberger, 1928, *Euryspilus* sp , *Bubastes iridescens* Thery, 1910, *Bubastes* sp (? *inconsistans* Blackburn, 1888), as well as of many other Buprestinae and Chalcophorinae genera were studied and compared It was found that each of these subfamilies is characterized by its own evolutionary trend in specialization of antennal sensory formations, which we called buprestinoid and chalcophorinoid ones correspondingly Some separate conditions of morphoclines might be partly coinsided in both taxa Chalcophorinoid type is characterized by dispersion of peg-like coeloconic sensillae, arising one by one or by groups from small cuticular depressions, over both antennomere's surfaces (Figs 46–51) The further specialization leads to the fusion of separate elements (oligomerization) into either large apical depression, which is usually shifted to internal surface (Fig 53) (Sphenopterini, *Chalco-*

phorella Kerremans, 1903 and some others), or into numerous small depressions dispersed over both internal and external surfaces. In many cases both types of depressions are presented together. Buprestinoid type is characterized by the presence of singular large apical or subapical depression and field of peg-like basiconic or styloconic sensillae, arising from surface or the tops of cuticular tubercles, on the internal antennomere's surface only. Sometimes the additional large depressions arise in place of sensillar fields. Coeloconic sensilla are rather rare in occurrence (Fig. 52) (no coeloconic sensillae were found among other Bubastini studied). Further specialization of buprestinoid type of antennae leads to forming of regular in shape subapical (some Buprestini, Stigmoderini, Dicercini, etc.) or apical fossae (Kisanthobiini, Anthaxiini, *Anilara* Thomson, 1879 *Neocuris* Fairmaire, 1877, etc.) and cavities (Melanophilini, *Melobasis* Laporte & Gory, 1837, *Merimna* Thomson, 1878, *Chrysobothris*, etc.).

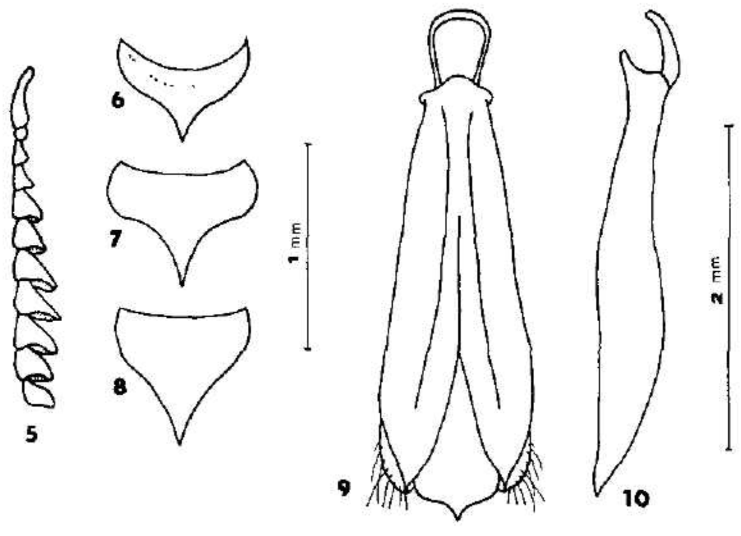
Comparative morphological analysis has shown that the antennae of *Paratassa* (Figs 46, 47) belong to chalcophorinoid type while antennal structure of *Bubastes* (Fig. 52) and other members of Bubastini correspond to buprestinoid one. There is obvious resemblance between sensory formations of Bubastini and those of some other Australian Buprestini, among them *Microcastalia* Heller, 1891 and *Buprestina* Obenberger, 1923. *Paratassa* is also characterized by the sex-associated variation of antennae, which is manifested itself as a size and form of antennomeres (Figs 46, 47). Otherwise the antennae of *Paratassa* are markedly similar to these of *Nanularia*



Figs 1–4 Body shape of *Paratassa* spp 1–*P occidentalis* sp. n , holotype, 8 9 mm 2–*P tunesiaca* sp n., holotype, 7 3 mm 3–*P acuminata* sp n , holotype, 5.5 mm. 4–*P. orientalis* sp. n., holotype, 6.4 mm.

Casey (Figs 48, 49), *Ampheremus* Fall, 1917 (Figs 50, 51), Sphenopterini (Fig. 53), *Chalcoplia* Thomson, 1881 and some other genera of Catoxanthini and Chalcophorini. Among Sphenopterini the change may be observed from undifferentiated, irregular subapical fossae (*S. (Sphenopterella* Volkovitsh & Kalashian, 1994*)*, *Genestia* Théry, 1923) to well differentiated, regularly round fossae (Fig. 53) (*S. (Sphenoptera)*, *Evagora* Kerremans, 1893, *Armenosoma* Waterhouse, 1887). The antennal sensory formations of above-mentioned genera correspond to mostly generalized, primitive condition of chalcophorinoid type, which is characterized by antennomeres transverselly broadened, mainly singular sensillae more or less evenly dispersed over surface, and poorly differentiated, irregular subapical fossa. By this means the similarity of antennal structure of these genera based on a symplesiomorphy.

In regard to larval structures, *Paratassa* is characterized by the set of autapomorphies, which correspond to most primitive conditions of some characters among Chalcophorinae and Buprestinae. They are as follows: the absence of developed apical cavity on the top of 2nd segment of antennae (Fig. 35) (this condition is characteristic of agriloid taxa), palantinae sclerites of labrum (Fig. 36) with poorly developed lateral branches (Fig. 36, lb) and, on the other hand, well developed median branches (Fig. 36, mb) (among the known larvae the similar condition was found in *Kisanthobia* only), poorly developed armature of external surfaces of labrum and labium, consisting only of microsetae along the anterior margin (Figs 36, 38) (similar condition is characteristic of some Polycestinae while Acmaeoderini and Anthaxiini have labrum and labium completely glabrous externally). The presence of long bristles on the postmentum (Fig. 38, ps) (the same was found in Australian *Prospheres* Thomson, 1878, *Neocuris* Fairmaire, 1877 and *Melobasis* Laporte & Gory – these bristles are strongly reduced or absent in all the other known representatives of buprestoid complex). Spiracles without inner trabeculae (Figs 39, 40) correspond to intermediate condition from uni- and multicamerate spiracles of many Acmaeoderini, as well as *Ptosima* Solier, 1833 and *Thrincopyge* LeConte, 1837 to ones of general buprestoid type, which are characterized by slot-like peritreme (Fig. 39) and strongly branching, abundant inner



Figs 5–10. 5 – male antenna of *P. aurulenta* sp. n., 6 – scutellum of *P. aurulenta* sp. n. 7 – the same, *P. coraebiformis* (Fairmaire). 8 – the same, *P. occidentalis* sp. n. 9 – aedeagus of *P. aurulenta* sp. n., dorsal view. 10 – the same, lateral view

trabeculae Prothoracic plates have no sclerotized tubercles or asperities and they are incompletely covered only with homogenous microteeth together with vast glabrous areas (Figs 41–43) (similarly to *Thrincopyge* and *Prospheres*)

As for the possible relationship of *Paratassa* to other buprestoid taxa besides the resemblance in antennal structure, the following characters should be noted only vaguely resemblance in the structure of pronotal grooves with *Nanularia*, Sphenopterini and some other Chalcophorinae, obvious similarity in the shape of labrum and labium with *Nanularia* (but the latter clearly differs by microspinulated external surfaces of both labrum and labium, and palantine sclerite of labrum with normally developed lateral branches) *Nanularia* also differs by absence of projections on the anterior margin of epistome and disposition of epistomal sensillae, prothoracic plates evenly covered with microteeth, and some other features

In conclusion it may be said that by the antennal structure and larval features *Paratassa* is characterized by the set of autapomorphies and occupy the isolated position at the base of the chalcophorinoid lineage of buprestoid complex, having some vague resemblance to *Nanularia*, though their close relationship is rather doubtful From our viewpoint *Paratassa* should be separated as a distinct tribe Paratassini tribe nov of the same status as Sphenopterini

Paratassa Marseul, 1882

Paratassa Marseul, 1882 167

Type species *Sphenoptera caroli* Marseul, 1882 168

Description Medium-sized, cylindrical, very convex species with metallic colouration (Figs 1–4) golden green, blue-green, coppery-bronze or reddish-bronze Ventral side usually covered with more or less developed white tomentum Frons and lateral pronotal margins with short, pronotal disc and elytra with very short, white and sparse pubescence Ventral side with sparse but long and semierrected, white pubescence

Head rather large, frons shallowly depressed, flat or slightly convex, vertex convex Epistome very wide with broadly and shallowly incurved anterior margin Eyes small, elliptical, not projecting beyond outline of head Antennae long, reaching posterior pronotal angles in male, distinctly shorter in female First antennal segment very long, bent or nearly straight, sometimes slightly claviform Segments 4–10 very enlarged in male, moderately enlarged in female, always wider than long (Fig 5) Sculpture of head consisting of rounded, deep and dense cup-like punctures (densely foveolate according to Harris 1979)

Pronotum 1 20–1 35 times as wide as long, very convex, sometimes nearly ball-shaped Anterior pronotal margin regularly arched or distinctly lobate, posterior margin straight with two lateral incurvations at posterior angles (Figs 1–4) Lateral pronotal margins regularly rounded in anterior half, straight or slightly incurved in posterior half, sometimes pronotum a little bell-shaped Very rarely there are two small, rounded and shallow depressions on the disc Pronotal sculpture consisting of rounded or transversely slightly enlarged, deep punctures (densely foveolate Harris 1979) of the same type as those on head These punctures form rather often transverse wrinkles on basal half of pronotum (striate Harris 1979) Pronotum bordered by fine, sharp keel reaching from posterior angles as far as to anterior angles Scutellum subcordiform with long and sharp posterior apex Anterior margin of scutellum nearly straight or more or less incurved (Figs 6–8)

Elytra 1 7–2 0 times as long as wide at humeral part with well-developed humeral swellings, subparallel or distinctly wedge-shaped (Figs 1–4) Each elytron rounded separately, sometimes elytra with traces of longitudinal grooves Subhumeral lobe large, reaching the level of hind

coxae, epipleuras missing. Elytral sculpture (foveolate: Harris 1979) consisting of deep and large, cup-like punctures, sometimes with slight transverse wrinkles on humeral part. Lateral margins of elytra very feebly serrate at apical third.

Ventral side of prothorax roughly, abdominal sternites finely punctured. Prosternum margined anteriorly, prosternal process wide and convex. Anal sternite widely rounded in both sexes. White tomentum covering ventral side of the most species is well-visible only in fresh and well-preserved specimens (except *P. aurulenta* sp.n. where the tomentum is very thick and stabil). Legs rather short and slender, tarsi very long, usually as long as tibiae, only posterior tarsi distinctly shorter than tibiae. Anterior tibiae straight or slightly arched on outer margin in male, with large and sharp grains or small spines (Figs 28–30).

Aedeagus (Figs 9–19) flattened, somewhat spatulate, very often Y-shaped or V-shaped, ones or twice dorsolaterally bent (lateral view). Ovipositor (Figs 20–27) short and rather sclerotized with well-developed outer pubescence and terminal setae.

Bionomy. All species of the genus seem to be associated with desert and semidesert Brassicaceae (genera *Oudneia*, *Diplotaxis*, *Launaea*, *Moricandia*, *Crambe*, *Lepidium* etc.). Larvae take their development in roots of these plants, flying holes are usually situated at the level of soil surface. The general form of ovipositor indicates ovipositing at the base of plant through the layer of sand or soil. Adults are not good flyers, flying usually only on short distance during the warmest hours of the day.

Distribution (Fig.31). The genus is distributed from Morocco to south Iran, inhabiting desert and semidesert regions usually in lower elevations (except *P. occidentalis* sp. n. and *P. medio-atlassica* sp. n. occurring on mountain steppes of the High and Middle Atlas).

Key to species of *Paratassa*

1 (2) Pronotum finely granulated in posterior half, grains are somewhat transverse on prescutellar region. Anterior margin of scutellum deeply incurved (Fig 6). Anterior male tibiae distinctly bent and shorter than tarsi (Fig. 28) Golden-bronze or red-bronze species. Aedeagus Figs 9, 10, ovipositor Fig 20 8 5–12 0 mm, Algeria (El Golea, Ghardaia) . . . . *P aurulenta* sp n

2 (1) Pronotum with rather deep, rounded or oval punctures which are sometimes changed into transverse wrinkles on prescutellar region Anterior margin of scutellum straight or feebly in curved (Figs 7, 8) Anterior tibiae almost straight (Figs 29, 30), as long as tarsi or slightly longer Golden green, blue-green, rarely bronze-green species

3 (8) Body stout, short and robust, elytra only 1 7–1.8 times as long as wide at humeral part (Figs 2, 3), pronotum very convex

4 (5) More acumined species, frons with shallow and wide depression (Fig 3) Elytra with slight traces of longitudinal grooves Bronze-green or blue-green, lustrous species Aedeagus Fig. 15, ovipositor Fig 22 Israel, Sinai 5 0–7 0 mm . . . . *P acuminata* sp n

5 (4) Shorter, subparallel and more robust species, frons flat or very slightly depressed (Fig 2). Elytra without any traces of longitudinal grooves

6 (7) Smaller species, lateral pronotal margins straight in posterior half (Fig. 2) Sculpture of basal half of pronotum consisting of regular, slightly transversely enlarged punctures Blue-green, rather dark and matt species. Aedeagus Fig 18, ovipositor Fig 26 6 0–7 0 mm Tunisia . . . . *P. tunesiaca* sp n

7 (6) Larger species, lateral pronotal margins slightly incurved before posterior angles. Basal part of pronotum with transverse wrinkles between prescutellar part and posterior angles Matt, bronze-green species Aedeagus Fig 17, ovipositor Fig 27 7 3–8 0 mm Egypt . . . . *P aegyptiaca* sp n

8 (3) Body more slender and less robust, elytra 1 9–2 0 times as long as wide at humeral part (Figs 1, 4) Pronotum less convex, rarely with two, small, indistinct and rounded depressions on anterior half.

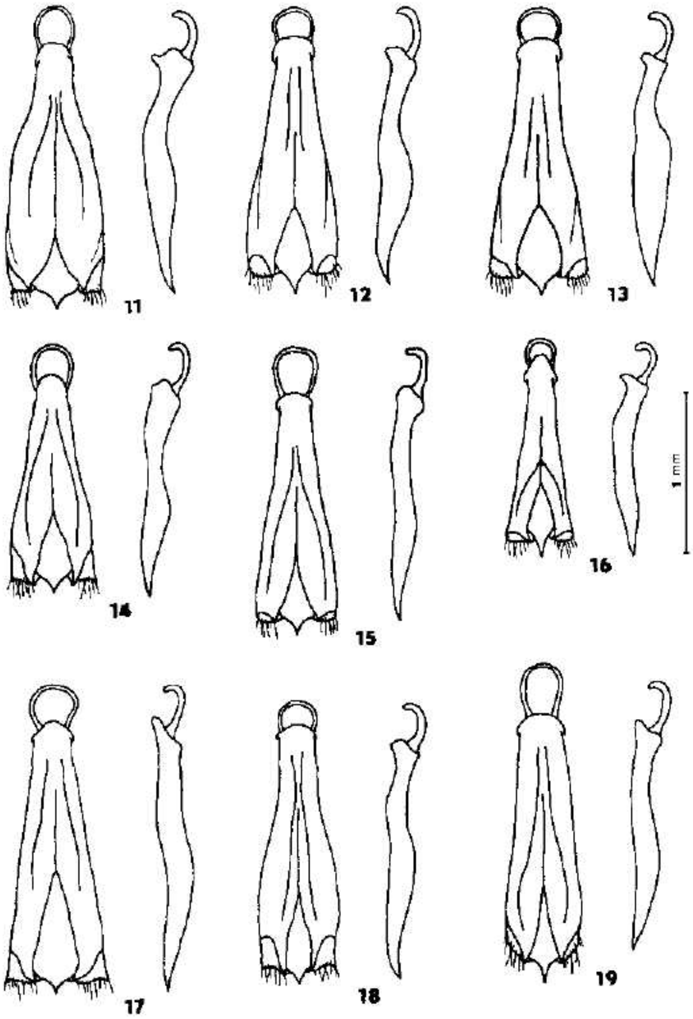
9 (14) Frons flat or slightly convex, elytra more tapering posteriorly (Fig. 4). Golden-green, rarely blue-green species with golden lustre

10 (11) Frons flat, the widest part of pronotum at base, pronotum very slightly bell-shaped. Male protibiae straight on outer margin (Fig 20). Aedeagus Fig. 11, ovipositor Fig. 25. 6.5–10 0 mm. Algeria, Tunis . . . . *P. coraebiformis* (Fairmaire)

11 (10) Frons slightly convex (Fig 4), lateral pronotal margins subparallel or nearly subparallel, male protibiae more convex on outer margin (Fig. 29)

12 (13) Lateral pronotal margins nearly subparallel in posterior half and less rounded in anterior half (Fig 4). Sculpture of posterior half of pronotum consisting of regular, rounded or slightly transverse punctures Blue-green, rather matt species with indistinct golden lustre. Aedeagus Fig. 14, ovipositor Fig. 24. 6.5–8.2 mm. SW Iran. .... *P orientalis* sp n

13 (12) Lateral pronotal margins parallel in posterior half, posterior angles somewhat prominent. Anterior half of pronotal margins strongly rounded. Punctures on posterior part of pronotum transversely fused, forming short wrinkles Golden green, more lustrous species. Aedeagus Fig 19, ovipositor Fig. 23. 6.5–8.0 mm. S Algeria (Tassili Mts) .... *P. meridionalis* sp. n.



Figs 11–19 Aedeagi of *Paratassa* spp. (dorsal view – left, lateral view – right). 11– *P. coraebiformis* (Fairmaire) 12– *P occidentalis* sp n 13– *P mediatlassica* sp n 14– *P. orientalis* sp. n. 15– *P. acuminata* sp. n 16– *P. arabica* sp n. 17– *P. aegyptiaca* sp n 18– *P. tunesiaca* sp. n 19– *P. meridionalis* sp. n.

14 (9) Frons distinctly depressed, elytra less tapering posteriorly (Fig. 1). Blue-green species sometimes with slight golden lustre which is more distinct on elytra than on the pronotum.

15 (16) Elytra with distinct traces of longitudinal grooves. Larger and somewhat more robust species (Fig 1) Aedeagus Fig 12, ovipositor Fig 21 7.0–10.0 mm Morocco (High Atlas). .. .. *P. occidentalis* sp n

16 (15) Elytra without any traces of grooves, smaller and more slender species.

17 (18) Slender, subcylindrical species with nearly parallel elytra Lateral pronotal margins subparallel, ventral side without tomentum, only with long, white hairs. Aedeagus Fig. 13, female unknown. 5.0–6.4 mm. Morocco (Middle Atlas). .. ... *P mediaatlassica* sp. n

18 (17) More robust species, elytra more tappering posteriorly. Pronotum slightly bell-shaped, the widest part of pronotum at base. Ventral side, besides of long, white hairs, also with white tomentum. Sculpture of dorsal side more rough Aedeagus Fig. 16, female unknown. 6.5 mm. Saudi Arabia. ...... *P arabica* sp n

Paratassa coraebiformis (Fairmaire, 1875) (Figs 7, 11, 25, 30)

Sphenoptera coraebiformis Fairmaire, 1875. 511.
Sphenoptera caroli Marseul, 1882 168

Medium-sized, subcylindrical and lustrous species, dorsal side blue-green, golden green sometimes with golden tinge. Ventral side golden green, less lustrous. Head and lateral pronotal margins with short, white pubescence, disc of pronotum and elytra with very short, white pubescence. Ventral side and legs with rather long and sparse, white pubescence, whole ventral side usually covered with white tomentum.

Head rather large, frons flat or shallowly, triangularly depressed between eyes. Clypeus very broad, its anterior margin widely and shallowly incurved. Eyes very small, widely eliptical, not projecting beyond outline of head. Antennae long, reaching posterior pronotal angles in male, slightly shorter in female. First antennal segment very long and slightly bent, somewhat claviform, second segment very short, almost spherical, third segment twice as long as wide, slightly triangular. Segments 4–10 enlarged, 1.5 times as wide as long, somewhat showel-shaped in male, last segment pear-shaped in both sexes. Sculpture of head consisting of small, deep, rounded and very dense cup-like punctures.

Pronotum strongly convex, slightly bell-shaped, 1.3 times as wide as long with broadly arched anterior margin. Posterior margin nearly straight in middle and widely incurved near posterior angles. Lateral pronotal margins rounded in anterior half, nearly straight in posterior half and slightly incurved before posterior angles. The widest part of pronotum at the base. Pronotal sculpture consisting of punctures which are similar to those on head but not so dense, punctures on posterior half of pronotum somewhat transversely enlarged forming sometimes short wrinkles. Scutellum subcordiform (Fig. 7), slightly incurved anteriorly, prolonged and sharply pointed apically.

Elytra very convex, subcylindrical, 1.9–2.0 times as long as wide at humeral part, humeral swellings small but well-developed. Each elytron separately rounded apically and very finely serrate in posterior third. Elytra deeply, irregularly punctured, punctures became finer and smaller towards elytral apex. The widest part of elytra at humeri, then elytra slightly tapering posteriorly to the apical two thirds. Posterior third of elytra nearly straightly tapering to their tips, elytra with slight traces of longitudinal grooves.

Ventral side deeply and densely punctured, last abdominal sternite widely rounded in both sexes. Legs long and slender, all tibiae of both sexes sharply granulated, nearly serrate on outer margin (Fig. 29). Tarsi very long, anterior and middle tarsi as long as tibiae, posterior tarsi slightly shorter.

Aedeagus (Fig 11) enlarged, spatulate, basal part of parameres conspicuously bent (lateral view) Ovipositor Fig 25

Length 6 5–10 0 mm, width 1 6–3 0 mm

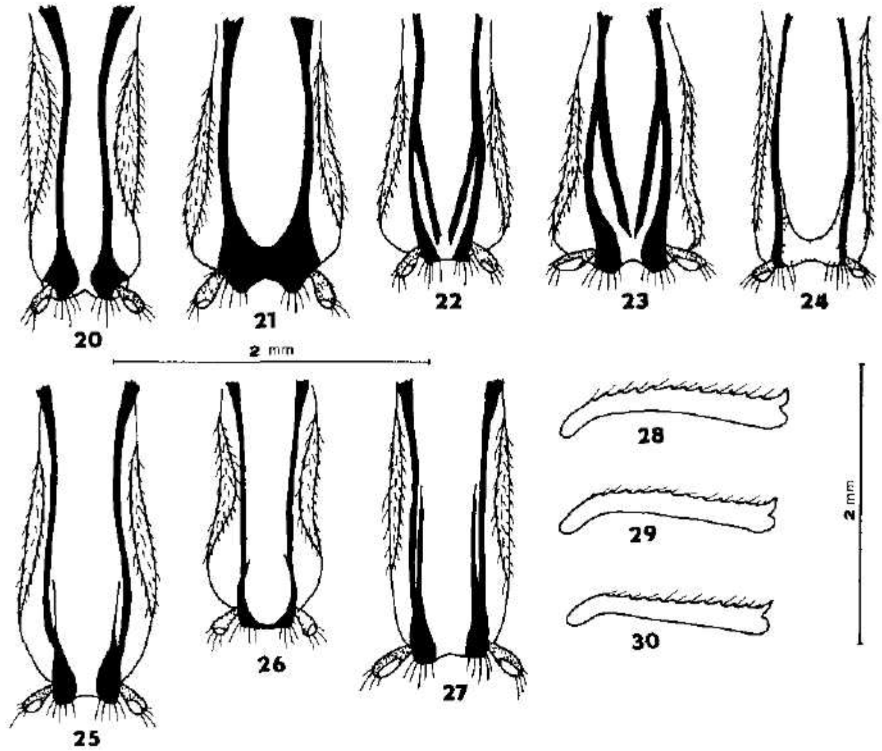
SEXUAL DIMORPHISM Female differs from male only by shorter and less enlarged antennae and usually by larger size

BIONOMY Larva developes in roots of *Launaea arborescens*, according to Théry (1930) also in *Moricandia arvensis* (Brassicaceae)

DISTRIBUTION (Fig 31) Northern Algeria, Tunis

NOTE Théry (1930) studied the type specimen of *Paratassa coraebiformis* (MCSN) and compared it with the type of *P caroli* (MNHN) and he did not find any differences and supposed them to be conspecific We have studied the type in MNHN and also according to the Marseul's description (Marseul, 1882) there is no doubt about the conspecificity of both species

MATERIAL EXAMINED Algeria Bou Saada, 3 v 1987, S Bily and V Kubaň leg (23 spec), Ghardaia 2 v 1987, S Bily leg (2 spec) El Golea, 3 v 1987 (5 spec), Oumache, Dr Martin leg (1 spec), Biskra, Dr Martin leg (7 spec), Ain Sefra, Thery leg (2 spec) Biskra, v 1885, L Bleuse leg (3 spec), Ain Sefra, Bir-Senia, 30 vi 1986 (11 spec), Béchar, Menres, 8 vi 1986 (1 spec), Batna El Kantara, 29 v 1986 (6 spec), Algeria (without more detailed data) 22 spec Tunis Tamaghza, A Kerim leg (1 spec), Tunis (without more detailed data) 3 spec



Figs 20–30 20–27 ovipositors of *Paratassa* spp 20–*P aurulenta* sp n 21–*P occidentalis* sp n 22–*P acuminata* sp n 23 *P meridionalis* sp n 24–*P orientalis* sp n 25–*P coraebiformis* (Fairmaire) 26–*P tunesiaca* sp n 27–*P aegyptiaca* sp n 28–30 male protibiae 28–*P aurulenta* sp n 29–*P orientalis* sp n 30–*P coraebiformis* (Fairmaire)

Description of larva

MATERIAL EXAMINED 2 larvae and 1 prepupa Algeria, Ghardaia, 2 v 1987, ex *Launaea arborescens*, S Bily leg (2 larvae) Algeria, Ghardaia, 2 v 1987, ex *Launaea* sp , V Kubáň leg Specimens deposited in ZMAS and NMPC

Length of different instar larvae 10.9 – 16 9 mm Larva (Fig 41) is of the usual buprestid type with moderately enlarged prothorax, corresponding to the 2nd morpho-ecological type of *Acmaeoderella* larva (Volkovitsh 1979) Body of preserved larvae whitish to dirty-cream with brownish mouth- parts ans spiracles Segments of prepupa are distinctly transverse while larval segments are longitudinal

HEAD AND MOUTHPARTS Epistome (Fig 32) about 4 5 times as wide as long, anterior margin slightly angularly emarginated between the mandibular condyles which are large, bearing strong antero-lateral projections (Fig 32, ep) and deep emarginations between these projections and mandibular condyles Posterior margin deeply bisinuate, latero-posterior corners blunt, weakly obtuse-angled, nearly rectangular and projecting Lateral margins with deep, oblique antennal incisure, epistome bearing 2 groups of 3 epistomal sensillae (Fig 32, es) arranged in shape of trapeze divided by sclerotized strip in the middle Each group consists of 2 short trichoid and 1 campaniform sensillae, the latest disposed slightly above and middleward anterior pair of trichoid sensillae Clypeus (Fig 36) narrow, membranous, glabrous, with anterior margin nearly straight

Labrum (Fig 36) slightly transverse, its anterior margin slightly convex between angularly rounded antero-lateral margins, without lateral lobes and with slightly curved, nearly parallel sides Palantine sclerites large, well marked, transverse, with strong sclerotized median branches (Fig 36, mb) (terminology follows Volkovitsh & Hawkeswood 1995) and hardly developed, weakly sclerotized lateral ones (Fig 36, lb) which are not jointed each other Each of median branches bearing dorsally 3 median sensillae of labrum (Fig 36, msl) 1 long apical seta which far extending the anterior margin of labrum and 2 campaniform sensillae situated below apical seta posteriorly of middle line of labrum almost on the same level The distance between apical seta and both campaniform sensillae almost equal Antero-lateral sensillae (Fig 36, alsl) includes 3 sharp setae and 1 campaniform sensilla externally and 3 blunt setae near the antero-lateral margin and 1 campaniform sensilla on each side internally External sensillae arranged as follows on either side one seta and campaniform sensilla situated next each other just above the apices of median branches of palantine sclerite, 1 sharp seta near the antero-lateral corners of labrum and 1 sharp seta on the lateral branches near their apices The position of antero-lateral sensillae is as follows

$$\frac{(1t,2c)+3t+4}{1t+2t+3t-4c}$$

with external sensillae designations in the numerator and internal ones in the denominator (+,2,3, – the ordinal number of sensilla from most median to lateral ones, which may be not homologous in different taxa /t– trichoid, c– campaniform sensillae,"()" – with fused bases,"+" – with closed bases, „–" – with distant bases see Volkovitsh & Hawkeswood 1995) External surface of labrum also with narrow transverse band of microsetae along the middle of anterior margin, with almost straight posterior margin which is situated about 1/4 the distance from the anterior margin of the labrum to the bases of apical median sensilla, remained surface glabrous Labrum ventrally (epipharynx) with narrow, almost subparallel bands of microspinulae extending from the anterior margin to the base of the labrum and surrounding the pharynx

Antennae (Fig 35) two-segmented, situated in the deep posterio-lateral incisure of epistome Articulae membrane glabrous, not forming a cover around 1st segment which is only hardly

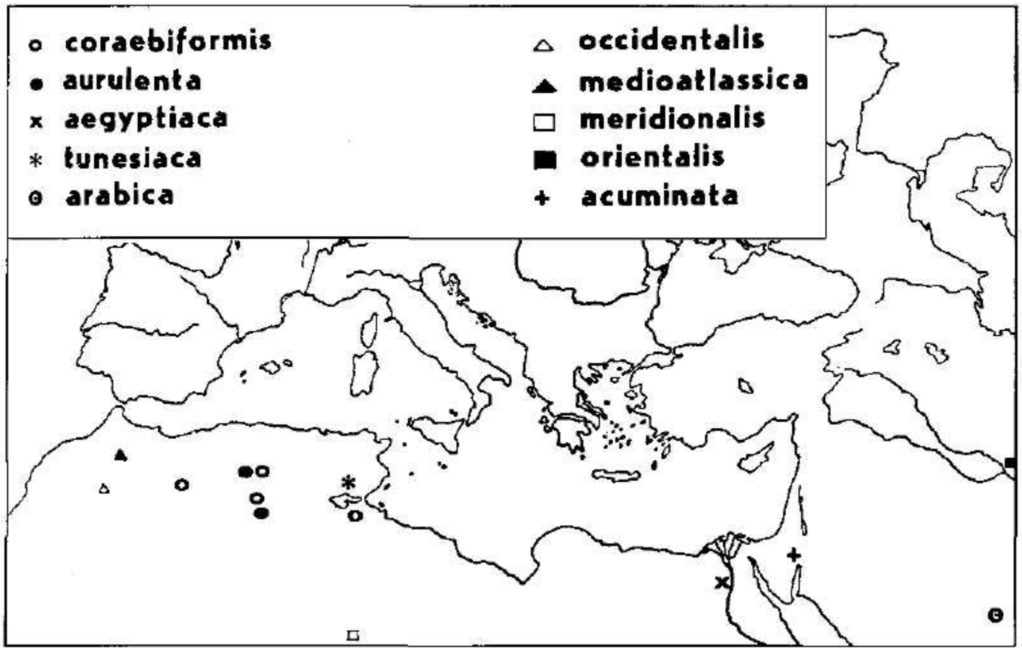


Fig.31. Geographical distribution of the genus *Paratassa* Marseul.

envaginated to membrane with its basis. First segment broadly cylindrical, slightly broadened toward the apex, hardly longer than segment 2, about as long as wide, strongly sclerotized. First segment with a narrow fringe of rather dense microspinulae along the anterior margin surrounding the basis of the 2nd segment, with a campaniform sensilla externally applroximately in the middle and another one internally near the apex and external margin. Second segment cylindrical, slightly longer than wide with glabrous anterior margin, with very long sharp trichosensilla which is approximately 2 times longer than the length of 2nd segment and with practically undeveloped apical cavity. The apex of 2nd segment partly covered with membrana anteriorly, bearing a sensory appendage (Fig. 35, sa) (often regarded as 3rd antennal segment) extending outside the membrana, and basiconic sensilla (Fig. 35, bs) at its basis – both structures are situated on the apex of tubercle. There are also 2 small palmate sensillae next to the basis of tubercle.

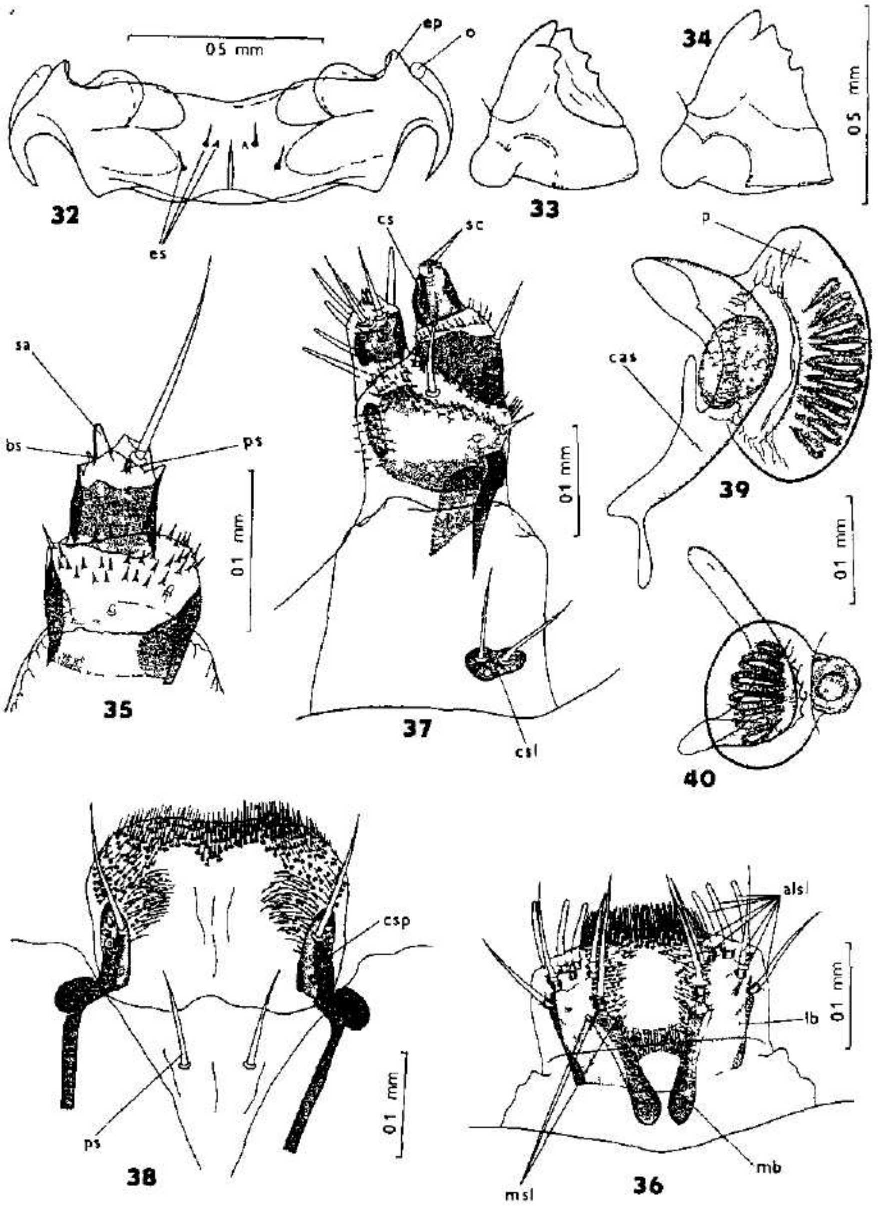
Mandibles (Figs 33, 34): almost black at anterior half, lighter at the basis, strongly sclerotized, broadened at the basis, triangular and nearly as long as wide. Cutting edge with 6 markedly developed teeth, apical tooth is the biggest, sharpened at its apex. Ventral edge bearing 2 teeth situated on the common basis, dorsal edge with 2 teeth situated on the common basis and with a little additional tooth bellow them.

Hypostome. Slightly sclerotized except for condylar recesses to attaching of mandibles, bearing singular trichoid and campaniform sensillae situated on the different levels. Pleurostome bearing weakly sclerotized structures which are supposedly the ocelli (Fig. 32, o).

Labiomaxillary complex (Figs 37, 38) Maxillae (Fig 37) Maxillary cardo membranous *glabrous, with 2 long, sharp setae and one campaniform sensilla situated on a distinct, isolated,* rather large and well-sclerotized sclerite (Fig 37, isl) in the postero-lateral corners near the cardo basis Stipes with a strongly sclerotized internal sclerite bearing one campaniform sensilla closer to external margin, one very short sharp seta near the latero-external margin above the anterior margin of internal sclerite and one long sharp seta near the anterior margin below the basis of maxillary palpus, extending to about a half of 2nd segment Anterior margin externally with a fringe of rather long, sharp microspinulae arising from membranous tubercles, denser on the external corners Stipes internally with short and sparse microspinulae along internal and anterior margins, extending to the mala Maxillary palpus two-segmented Basal segment strongly sclerotized, nearly triangular bearing a long, sharp seta arising from near the anterio-lateral corner, not extending the apex of segment 2, and a campaniform sensilla situated closer to the middle of external margin Anterior margin with sparse, rather short microspinulae arising from the membranous tubercles Second segment elongate, about 1 5 times longer than wide markedly sclerotized, with one long modified and curved sensilla (Fig 37, cs) internally, one campaniform sensilla externally, and about 7 small conical sensory structures (Fig 37, sc) at its apex Mala markedly sclerotized with a broad internal sclerite, almost rectangular and parallel-sided, about 1 3 times as long as wide Mala externally with one campaniform sensilla at the middle, 2 long sharp setae near the apex and 2 closed and short, peg-like sensillae at the apex Internally mala bears 6 long, thick spinae situated along the anterior and internal margins and very sparse microspinulae

Labium (Fig 38) slightly transverse, prementum about 1 4 times as wide as long with markedly emarginated anterior margin, broadly rounded antero-lateral corners and feebly emarginate lateral sides External surface of prementum glabrous except for narrow zone of dense microsetae along its anterior margin Internal surface with the same microsetae at the antero-lateral corners and sparse microspinulae along the lateral sides Corner sclerites of prementum (Fig 38, csp) each bearing one long, sharp, anteriorly directed setae extending the anterior margin and 5 small, campaniform sensillae Postmentum with 2 long, sharp setae (Fig 38, ps) extending the posterior 1/3 of corner sclerites of prementum

THORAX (Figs 41–43) Pronotal and prosternal plates poorly developed, irregularly covered with dense homogenous and feebly sclerotized microteeth, arising from the membranous tubercles (Figs 41 e, 42, 43, mz) and sparse, short bristles (Fig 41, f) which are most dense on prosternal plate Pronotum with glabrous areas surrounding the anterior part and the apices of branches of pronotal grooves (Fig 42, gz) Prosternum with a vast glabrous area around the anterior part of prosternal groove and two oblique, variable, glabrous zones beginning from vast area and nearly reaching the basis of prosternal plate (Fig 43, gz) Sides of prothorax with transverse microspinuled zone anteriorly (Fig 41, d), remaining parts glabrous with sparse bristles (Fig 41, c) Anterior prothoracic membrane irregularly covered with microspinulae forming the transverse zone and sparse bristles (Fig 41, b) along the anterior margin Microspinulae poorly developed at the middle (Fig 41, a) Sides of prothorax, posteriorly of microspinulate zone, glabrous with sparse bristles (Fig 41, c) Prothoracic grooves (Figs 42, 43) brownish, markedly sclerotized Pronotal groove (Fig 42) inverted Y-shaped forming a sharp angle, moderately or strongly sclerotized with strongly umbrella-like broadened, yellowish or brownish apical part divided into 2 slightly curved, closely situated branches in anterior 1/3 Prosternal groove (Fig 43) narrow, uniramous, irregularly sclerotized, yellowish or brownish, strongly umbrella-like broadened at the apical part and angularly broadened at the basis, divided there into two hardly sclerotized transverse branches



Figs 32–40 Larva of *Paratassa coraebiformis* (Fairmaire), mouth parts and spiracles 32– epistome (ep– epistomal sensillae o– ? ocellus) 33– right mandible 34– left mandible 35– right antenna (bs– basiconic sensilla, ps– palmate sensilla, sa– sensory appendage) 36– labrum (alsl– antero lateral sensillae of labrum, lb– lateral branch of palantinae sclerite, mb– median branch of palantinae sclerite, msl– median sensillae of labrum) 37– right maxilla (cs– curved sensilla, isc– isolated sclerite of cardo, sc– sensory cones) 38– labium (csp– corner sclerite of prementum, ps– postmental seta) 39– right thoracic spiracle (cas– closing apparatus, p– peritreme) 40– right abdominal spiracle

Mesothorax without distinct ambulatory pads on both surfaces, nearly completely covered with microspinulae except for areas around the spiracles and transverse strip at the base.

Metathorax with poorly marked glabrous ambulatory pads on the both surfaces, remaining surface microspinuled. Thoracic segments without rudiments of legs, with sparse, short bristles (Fig. 10, c) which are denser and longer on the lateral margins.

ABDOMEN (Figs 41, 44). Abdominal segments longer than wide, flattened with longitudinal, depressed zones laterally.

The first segment with distinct ambulatory pads ventrally, divided into three small tubercles (Fig. 44) with triangular membrane covered with poorly developed microtubercles between them. Segments 2–9 without ambulatory pads, irregularly covered with poorly developed microspinulae and sparse, short bristles which are denser on the lateral margins than in the middle.

Spiracles (Figs 39, 40). Thoracic spiracles (Fig. 39) nearly lenticulate or irregularly ovoid, about 1.7 times as long as wide, with markedly developed and weakly sclerotized peritreme and without any trace of inner trabeculae. Peritreme (Fig. 39, p) bearing a few chinked slots arranged nearly parallelly to each other and bordered with narrow, strongly sclerotized zones. The closing apparatus of spiracle (Fig. 39, cas) only weakly sclerotized.

Abdominal spiracles (Fig. 40) very variable, circular, oval or irregular in shape, about 1.4 times as long as wide. They differ from the thoracic spiracles only in their shape and size.

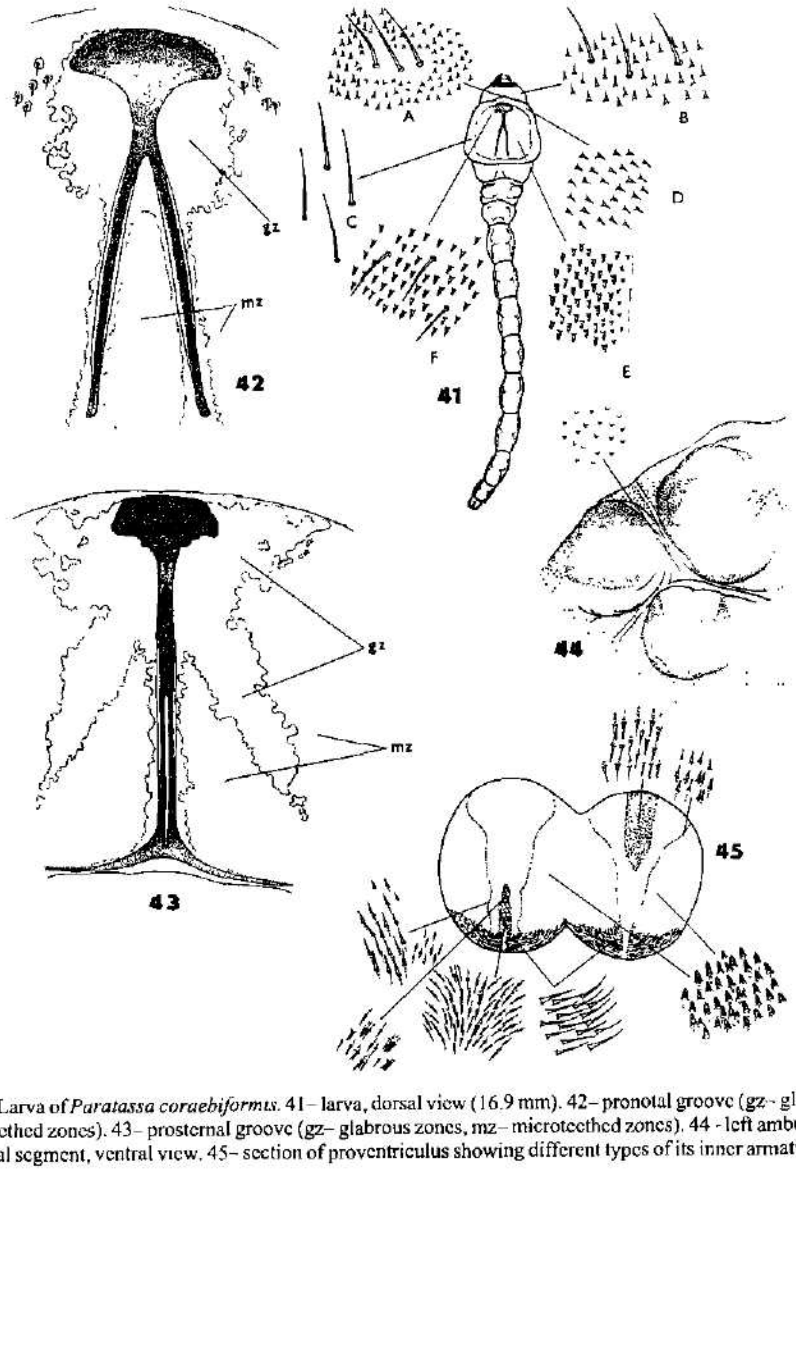
PROVENTRICULUS (Fig. 45). The morphology of the inner fields and their armature are rather ordinary. The armature includes microspinulae, microsetae and well-developed, sclerotized microteeth situated mainly one by one on the apices of scale-shaped tubercles with scleritized bases. The groups of microspinulae, microsetae and microteeth form a complicate pattern. Glabrous areas are rather broad, additional fields poorly developed.

The main diagnostic characters of Paratassa-larvae allowing clearly distinguish them from any other known buprestid-larvae are as follows: epistome (Fig. 32) bearing strong antero-lateral projections (Fig. 32, ep) and deep emarginations between these projections and mandibular condyles as well as epistomal sensillae arranged in shape of trapeze (Fig. 32, es); palantinae *sclerites of labrum (Fig. 36) with well-developed, strong sclerotized median branches bearing* the posterior projections (Fig. 36, mb) and hardly developed, weakly sclerotized lateral branches (Fig. 36, lb), medial and lateral branches not jointed each other (the similar situation is found in *Kisanthobia* only – in other buprestoid taxa the lateral branches are developed much better than *medial ones, jointed to them and bearing posterior projections; the medial branches usually* weakly sclerotized and without posterior projections); 2nd segment of antennae with practically undeveloped apical cavity (Fig. 35) bearing sensillar organs (Figs 35, bs, ps, sa) on its apex which is anteriorly only partly covered with membrana (this condition is characteristic of agriloid taxa); spiracles without any trace of inner branched trabeculae, with peritreme bearing a few chinked slots arranged nearly parallelly to each other (Figs 39, 40) (by their structure the spiracles of *Paratassa* bear a superficial resemblance to the spiracles of *Ptosima* (Bílý 1972) and *Thrincopyge* (Bílý 1986) occupying the intermediate position between those and spiracles of general buprestoid type which is characterized by cancellate peritreme and strongly branched inner trabeculae); prothoracic plates incompletely covered with homogenous microteeth (Figs 41–43) which remains glabrous areas surrounding the grooves and two oblique, variable and glabrous areas on prosternal plate (Fig. 43).

Additional diagnostic characters are as follows: mandibles with 6 strongly developed teeth on the cutting edge (Figs 33, 34), the external surface of labrum and labium which are mostly glabrous (Figs 36, 38) except from narrow strips of microsetae along the anterior margin, the presence of long bristles on the postmentum (Fig. 38, ps) and the armature of proventriculus (Fig. 45).

Paratassa occidentalis sp. n.
(Figs 1, 8, 12, 21)

Diagnosis. One of the largest species of the genus. Blue-green species with golden tinge which is more distinct on elytra than that on pronotum. It differs from other species of the genus by large, nearly parallel body, widely depressed frons (Fig. 1) and first of all by the shape of aedeagus (Fig. 12). Anterior margin of scutellum is nearly straight or very slightly incurved, elytra 1.9



Figs 41–45. Larva of *Paratassa coraebiformis*. 41 – larva, dorsal view (16.9 mm). 42 – pronotal groove (gz – glabrous zones, mz – microteethed zones). 43 – prosternal groove (gz – glabrous zones, mz – microteethed zones). 44 - left ambulatory pad of 1st abdominal segment, ventral view. 45 – section of proventriculus showing different types of its inner armature.

times as long as wide with fine but distinct, longitudinal grooves which are hardly visible or missing in other species. Ventral side with sparse, white tomentum only on meso- and metasternum, abdomen without tomentum only with long, sparse, white pubescence.

Aedeagus Fig. 12, ovipositor Fig. 21.

For the differential diagnosis see the key.

Length: 7.0–10.0 mm (holotype 8.6 mm), width: 2.2–3.0 mm (holotype 2.9 mm).

MATERIAL EXAMINED Holotype (male). Morocco, High Atlas, Tizi-n-Test, 4.–6 v.1995, J. Rolčík leg Allotype (female) The same data Paratypes (21 males,16 females) The same data (different collectors: J. Rolčík, J Fyman, S. Pokorný). Maroc, Haut Atlas, Tizi n' Test, 1900m, versante sud, 24 vi 1991, G Magnani leg.

Holotype and allotype deposited in NMPC, paratypes in NMPC, coll. Rolčík, Fyman and Pokorný (Prague), Niehuis (Alberswciler) and Mühle (Munich).

BIONOMY. All specimens were collected by sweeping of *Crambe filiformis* (Brassicaceae) in the elevation about 2500 m, larva takes its development in the carrot-like roots of this plant.
NAME DERIVATION. The specific name indicates the most western distribution of the genus.

Paratassa medioatlassica sp. n.
(Fig. 13)

DIAGNOSIS. Small and very slender species, very similar to *P. occidentalis* sp. n. from which it differs, besides smaller and more slender body, by less depressed frons and by somewhat longer elytra (2.0 times as long as wide) without any traces of longitudinal grooves. Ventral side quite without white tomentum.

Aedeagus (Fig. 13) with nearly Y-shaped parameres with straight outer margins (x laterally convex parameres in *P. occidentalis sp. n.*). Female unknown.

For the differential diagnosis see the key.

Length: 5.0–6.4 mm (holotype 5.0 mm), width: 1.7–2.1 mm (holotype 1.7 mm).

MATERIAL EXAMINED Holotype (male) Morocco, Middle Atlas, Azrou, 7. vi. 1995, S Pokorný leg. Paratypes (3 males) The same data (J Romsauer leg.)

Holotype and allotype deposited in NMPC, paratypes in coll. J Romsauer (Štúrovo, Slovakia).

BIONOMY. Also type specimens of this species were collected by sweeping of *Crambe filiformis* (Brassicaceae) which is the host plant of this species.
NAME DERIVATION. The specific name is derived from the locality: the Middle Atlas.

Paratassa meridionalis sp. n.
(Figs 19, 23)

DIAGNOSIS. Rather large, golden green species with moderately acumined elytra which are 1.95–2.0 times as long as wide. Frons convex, scutellum only very slightly incurved anteriorly. Lateral pronotal margins nearly parallel in posterior half, posterior pronotal angles slightly prominent. Ventral side completely covered with white tomentum.

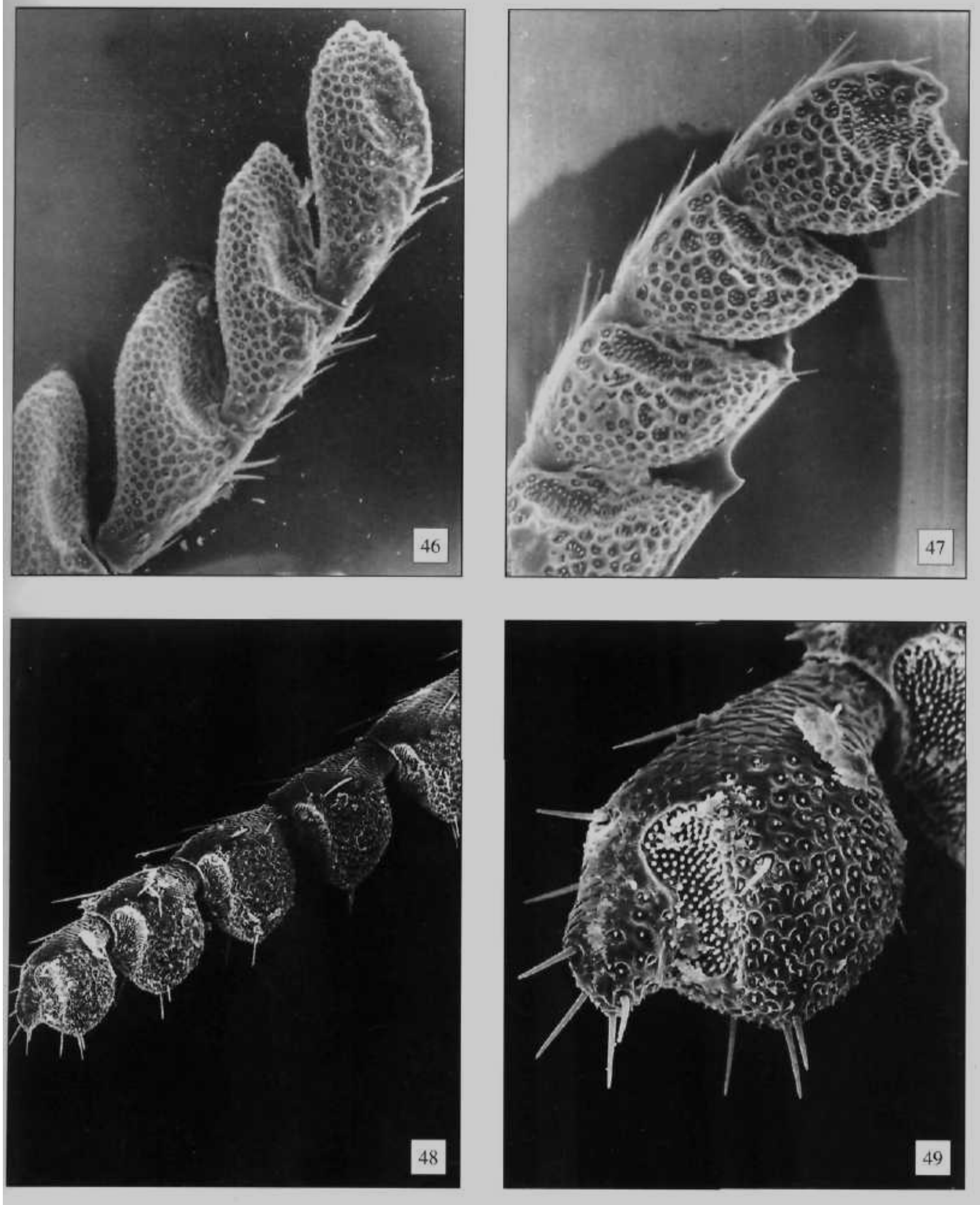
Aedeagus (Fig. 19) with nearly subparallel parameres, rather differring from other species of the genus. Ovipositor Fig. 23.

For the differential diagnosis see the key.

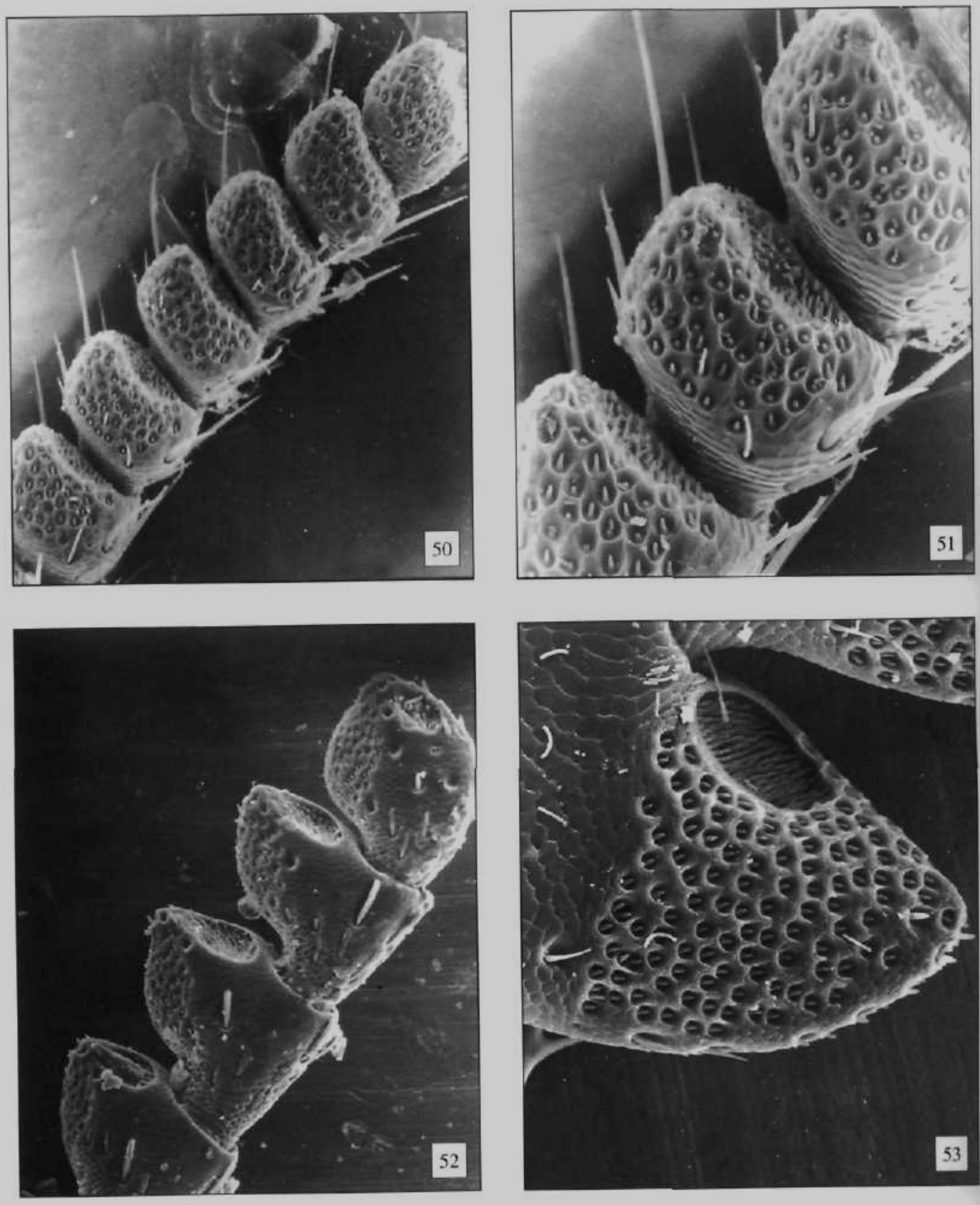
Length: 6.5–8.1 mm (holotype 6.5 mm), width: 2.1–3.1 mm (holotype 2.1 mm).

MATERIAL EXAMINED Holotype (male) Tassili orient., Amguit, 27 avril 1928, Farsetia. Allotype (female). Tassili n' Ajjer, Tamrit, 1700 m, 6–8. v. 1987, M. Škorpík leg., on *Launaea* sp. Paratype (male). The same data as allotype (F. Navrátil leg.)

Holotype deposited in NMPC, allotype in coll M. Škorpík (Znojmo), paratype in coll. F Navrátil (Brno).



Figs 46–49. Antennal structures. 46–*Paratassa coraebiformis* (Fairmaire), 8–11th segments of male, internal view, ×170. 47– the same, female, ×200. 48–*Nanularia brunneata* Knull, 7–11th segments of male, internal view, ×100. 49– the same, ×3000.



Figs 50–53. Antennal structures. 50– *Ampheremus cylindricollis* Fall, 6–11th segments, internal view, ×250. 51– the same, 6–8th segments, ×500. 52– *Bubastes* (? *inconstans*), 8–11th segments, internal view, ×170. 53– *Sphenoptera* (s. str.) *glabrata* Ménétriés, 7th segment, internal view, ×400.

BIONOMY. Unknown.
NAME DERIVATION. The specific name indicates the most southern distribution of the genus.

Paratassa aurulenta sp. n.
(Figs 5, 6, 9, 10, 20, 28)

Kerremans (1903) mentioned under *P. coraebiformis* also „var. *aurulenta* Théry" without any comment. Théry (1930) published „var. *aurulenta* Chobaut" and mentioned that his authorship in Kerremans (1903) is wrong. In the collection of MNHN there is a specimen labelled „*aurulenta* Chobaut" but Chobaut had never described any variety or species in the genus *Paratassa*. Neither Kerremans (1903) nor Théry (1930) described this variety (Théry only indicates the locality: Ghardaia) so we suppose it to be a nomen nudum. Because we suppose this form to be a distinct species and we have found in various collections several specimens determined as „var. *aurulenta*" with Chobaut, Kerremans or Théry as authors, we preserve the name „*aurulenta*" for this new species to avoid any confussion in the future.

DIAGNOSIS. The largest and most robust species of the genus. Due to its size, bright red-coppery colouration and pronotal sculpture there is very easy to recognize this species. Posterior half of pronotum with fine, grainy sculpture which is somewhat transverse on prescutellar region. Anterior male tibiae convex on outer margin (Fig. 28) and shorter than tarsi. Ventral side completely covered with dense, white tomentum.

Aedeagus Figs 9, 10, ovipositor Fig. 20.

For the differential diagnosis see the key.

Length: 8.5–12.0 mm (holotype 8.5 mm), width: 2.9–3.5 mm (holotype 2.9 mm).

MATERIAL EXAMINED. Holotype (male). Algeria, Sahara, El Golea, 29.–30. iv 1987, M. Škorpík leg. Allotype (female) Algeria, Reitter. Paratypes (2 males, 8 females) The same data as holotype (1 male) Algeria, Reitter (1 male, 4 females) Ghardaia, v 1897, A Chobaut (2 females). Ghardaia (1 female) Algeria, El Golea, 15 km Nord, G Sama leg., morte in colletta su *Oudneia africana*, iii. 1989 (3 further very destroyed females not included among paratypes)

Holotype and allotype deposited in NMPC, paratypes in NMPC, ZMAS, MNHN, coll M Škorpík (Znojmo) and G Magnani (Cesena)

BIONOMY. Holotype and one paratype were reared from the roots of *Launaea arborescens*, one paratype from *Oudneia africana* (both Brassicaceae).
NAME DERIVATION. The specific name is derived from the Latin adjective aurulentus = golden.

Paratassa tunesiaca sp. n.
(Figs 2, 18, 26)

DIAGNOSIS. Short, robust and cylindrical species (Fig. 2). Whole body dark blue-green, rather matt. Pro-, meso-, and metasternum with sparse, white tomentum, abdomen only with small, irregular patches of tomentum. Frons flat or slightly convex, elytra 1.7 times as long as wide, slightly tapering posteriorly without any traces of longitudinal grooves. Pronotum very convex, 1.2 as wide as long, lateral pronotal margins parallel in posterior half (Fig. 2). Sculpture of posterior half of pronotum consisting of regular, transversely enlarged, deep punctures.

Aedeagus (Fig. 18) with laterally convex parameres, ovipositor Fig. 26.

For the differential diagnosis see the key.

Length: 6.0–7.0 mm (holotype 6.7 mm), width: 2.3–2.7 mm (holotype 2.4 mm).

MATERIAL EXAMINED Holotype (male) Tunisia, Tataouine, 25. v 1993, R. Nerger leg. Allotype (female). Tunisia, v 1869. Paratypes (2 males, 2 females). Tunisia, Gafsa (2 males) S Tunesia, 3 km sw Matmata (Dahargebirge, Ksour-Berge), Schmid-Egger leg., 19. vi. 1994, Tu-Mat (female). Tunisie, Sfax, vi. 1949, El Djem (female).

Holotype and allotype deposited in NMPC, paratypes in NMPC, coll Niehuis (Albersweiler) and Magnani (Cesena)

BIONOMY. Unknown.

NAME DERIVATION. The specific name is derived from the country of the origin (Tunisia).

Paratassa acuminata sp. n.

(Figs 3, 15, 22)

DIAGNOSIS. The smallest species of the genus with bronze-green (male) or blue-green (female) body. Frons broadly and shallowly depressed, pronotum parallel-sided in posterior half, its anterior margin widely lobate in the middle (Fig. 3). Pronotum regularly, deeply punctured, 1.35 times as wide as long. Elytra 1.9 times as long as wide, slightly wedge-shaped (Fig. 3) with nearly indistinct traces of longitudinal grooves. Ventral side with white tomentum which is rather sparse on abdominal sternites.

Aedeagus (Fig. 15) nearly Y-shaped, parameres with nearly straight outer margins, ovipositor Fig. 22.

For the differential diagnosis see the key.

Length: 5.0–7.0 mm (holotype 5.7 mm), width: 1.8–2.9 mm (holotype 1.9 mm).

MATERIAL EXAMINED Holotype (male). Sinai, St. Kathleen monastery, 22. iv 1964 Allotype (female). Israel, loc no 26, Dead Sea, N Arugot, 22 –23 iv 1994, Volkovitsh et Dolgovskaja leg Paratypes (2 males, 3 females). The same locality as holotype (male) Israel, Sinai, Sct. Katarina, 29 vi 1976, O. Mehl leg (female) Israel, S Negev, loc no 6, Har Quetura, 4 km SE Shizzafou, 4 vii. 1996, Volkovitsh & Dolgovskaya leg. (male and female). Jordan, 21. vi 1994, Ma an Govem, Ras an Naqab (female).

Holotype deposited in NMPC, allotype in ZMAS, paratypes in NMPC, ZMAS, coll. H. Mühle (Munich) and M. Niehuis (Albersweiler)

BIONOMY. Unknown.

NAME DERIVATION. The specific name is derived from the latin adjective acuminatus = tapering and indicates the shape of elytra.

Paratassa aegyptiaca sp. n.

(Figs 17, 27)

DIAGNOSIS. Large and robust, dark golden green and matt species. Ventral side with large patches of white tomentum which is well-developed mainly on prosternum. Frons slightly convex, pronotum very convex, nearly ball-shaped, its lateral margins slightly incurved before posterior angles. Pronotal sculpture consisting of deep, transversely enlarged punctures which form distinct transverse wrinkles between prescutellar region and posterior angles. Elytra short, only 1.7 times as long as wide, gradually tapering from humeri to apex without any traces of longitudinal grooves.

Aedeagus (Fig. 17) V-shaped, parameres with straight outer margins, ovipositor Fig. 27.

For the differential diagnosis see the key.

Length: 7.3–9.0 mm (holotype 7.3 mm), width: 2.6–3.5 mm (holotype 2.6 mm).

MATERIAL EXAMINED Holotype (male) Aegypt v, Heluan, H Rolle Berlin W leg. Allotype (female) Aegypt, Cairo Paratypes (1 male, 1 female). Egypte, coll Alfieri, Jebel Asfar, 27 v 1937 (female). Aegypt, Kairo (male).

Holotype and allotype deposited in NMPC, paratypes in NMPC and ZMAS.

BIONOMY. Unknown.
NAME DERIVATION.The specific name is derived from the country of the origin (Egypt).

Paratassa arabica sp. n.
(Fig. 16)

DIAGNOSIS. Medium-sized, blue-green and lustrous species, resembling by its body-shape *P acuminata sp.n.* from which it differs by slightly bell-shaped pronotum which bears short, transverse wrinkles on prescutellar part and by the form of male genitalia. Ventral side completely covered by sparse, homogenous, white tomentum.

Aedeagus (Fig. 16) V-shaped, resembling that of *P. aegyptiaca* sp. n.

For the differential diagnosis see the key.

Length: 6.5 mm, width: 2.4 mm.

MATERIAL EXAMINED Holotype (male). El Hauta (Saudi Arabia)
Holotype deposited in NMPC

BIONOMY. Unknown.
FEMALE. Unknown.
NAME DERIVATION. The specific name is derived from the country of origin (Arabia).

Paratassa orientalis sp. n.
(Figs 4, 14, 24, 29)

DIAGNOSIS. Medium-sized, subparallel, matt and blue-green species with golden lustre (Fig.4). Ventral side completely covered with white, rather sparse tomentum. By its body-shape and colouration it resembles *P. medioatlassica* sp. n. from which it differs by flat frons, anteriorly less rounded pronotum with posteriorly slightly diverging lateral margins, simple pronotal puncturation and by different form of male genitalia.

Aedeagus (Fig.14) short, nearly Y-shaped, parameres with convex outer margins, ovipositor Fig.24.

For the differential diagnosis see the key.

Length: 6.5-8.2 mm (holotype 7.2 mm), width: 1.9–2.8 mm (holotype 2.3 mm).

Holotype (male) SW Iran, Mollasani, 45 km NW Ahwaz, 13 – 14 vi 1977, loc no 288, Exp Nat Mus Praha Allotype (female) the same data Paratypes (3 males, 1 female) the same data (3 males) Iran, Ahwaz/Ramshir, 100 m, 11 iv 1978, Reissinger leg (female).
Holotype and allotype deposited in NMPC, paratypes in NMPC and coll. H Mühle (Munich)

BIONOMY. All specimens collected by the expedition of the National Museum Praha were taken from *Diplotaxis hara*.
NAME DERIVATION. The specific name indicates the most eastern distribution of the genus.
NOTE. This species was erroneously treated as *P coraebiformis* (Fairmaire) by Bílý (1983).

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Description of the larva of *Schizogenius lineolatus* (Coleoptera: Carabidae: Clivinini)

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Abstract The larva of *Schizogenius lineolatus* Say, 1823, the first of the genus *Schizogenius* Putzeys, 1846 is described and the main character states are illustrated The larva of *Schizogenius* differ from those of *Clivina* Latreille, 1802 and *Dyschirius* Bonelli, 1810, the two other genera of Clivinini with described larvae, by the presence of a small apical process on each urogomphus, by the presence of two incised claws, and by the presence of an hyaline structure on each claw A key to the larvae of the three genera of Clivinini is provided

Larval description, key, Carabidae, Clivinini, *Schizogenius*, Nearctic region

INTRODUCTION

The genus *Schizogenius* Putzeys, 1846 belongs to the tribe Clivinini. It is distributed from southern Canada south to central Argentina, with one species, known only from the holotype, found in the Fiji Islands (Baehr 1983). Most species live along rivers or streams on barren gravel or on sand. Whitehead (1972) revised the North American fauna and treated many of the South American species. The author recognized then two subgenera: *Genioschizus* Whitehead, 1972 with 10 species and *Schizogenius* s.str. with about 65 species. Later, Whitehead & Reichardt (1977) reclassified *Listropus* Putzeys, 1863, until now treated as a valid genus, as a subgenus of *Schizogenius*. As pointed out by Whitehead (1966), *Schizogenius* is closely related to the genus *Halocoryza* Alluaud, 1919, which occurs on various islands in the western part of the Indian Ocean and the southern part of the Red Sea (Basilewsky 1973), and in the West Indies, Mexico (Yucatán Peninsula), and southern Florida (Whitehead 1969).

Larvae of *Schizogenius* are unknown. The purpose of this paper is to describe the larva of *S lineolatus* and point out its main characteristics.

MATERIAL AND METHODS

The study is based on examination of 7 L_1 reared from eggs laid by adults collected at Cap-Rouge, Québec, and from 12 larvae collected in the field by the author from the following localities CANADA Québec: Abercorn, Brome C D , 1 VII 1983 (1L_1), 9 VII 1983 (2L_{2-3}), Cap- Rouge, Québec C D , 27 VI 1983, (4L_1), St-Augustin, Portneuf C D , 4 VIII 1983 (4L_{2-3}), Rigaud, Vaudreuil C D , 14 VI 1976 (1L_1) All specimens are deposited in the Canadian National Collection of Insects, Ottawa

Two L_1 and three L_{2-3} were cleared in hot 10% KOH, impregnated with glycerine (see Goulet 1977), slide-mounted in glycerine, and studied under an interference contrast microscope at 100–400× Three L_1 and one L_{2-3} were critical-point-dried using CO_2, mounted with double-sided tape on SEM stubs, and coated with gold They were observed with a Zeiss 940A DSM scanning electron microscope at an accelerating voltage of 10 kv Other larvae were observed uncleared under a stereo microscope

Notation of primary setae and pores follows that of Bousquet & Goulet (1984), notation of secondary setae follows that of Bousquet (1985)

Larva of *Schizogenius lineolatus* Say, 1823

Recognition. The larva of *Schizogenius* differs from those of *Clivina* Latreille, 1802 and *Dyschirius* Bonelli, 1810 by the presence of a small apical process on the urogomphus, by the presence of two incised claws, and by the presence of an hyaline structure on each claw.

Description

First instar

Measurement. Width of cephalic capsule: 0.33–0.35 mm (n=3).

Color. Cephalic capsule yellow to brownish yellow; antennae, mandibles, and maxillae somewhat brownish; abdomen, including urogomphi, pale yellow.

Chaetotaxy. Seta FR_2 on frontale relatively long; setae FR_1, FR_3, and FR_4 subequal in length, about 0.5× length of FR_2; setae PA_4 and PA_8 on parietale subequal in length, about 0.4–0.5× length of PA_7; seta PA_8 posterior to level of PA_9; pore MN_6 on mandible about same level as MN_7; gMX on stipes with about 15 setae; length of seta MX_4 about 0.6× that of MX_5; seta MX_6 short, not or barely exceeding extremity of lacinia, located at basis of lacinia. Setae PR_2, PR_8, PR_{13}, and PR_{14} on pronotum relatively long, as long as PR_3; length of seta ME_{10} on meso- and metanota 0.8–1 0× that of ME_9; length of ME_{14} 0.7–0.8× that of ME_{13}. Seta TE_8 on tergites subequal in length to TE_7, length of seta TE_{11} 0.6–0.8× that of TE_{10}; length of seta UR_3 on tergite 9 about 0.4–0.6× that of UR_2; urogomphi with 5 long setae (UR_4–UR_8) (Fig. 5). Inner sternite with one additional seta. Seta TA_1 on tarsus close to TA_2 and TA_7.

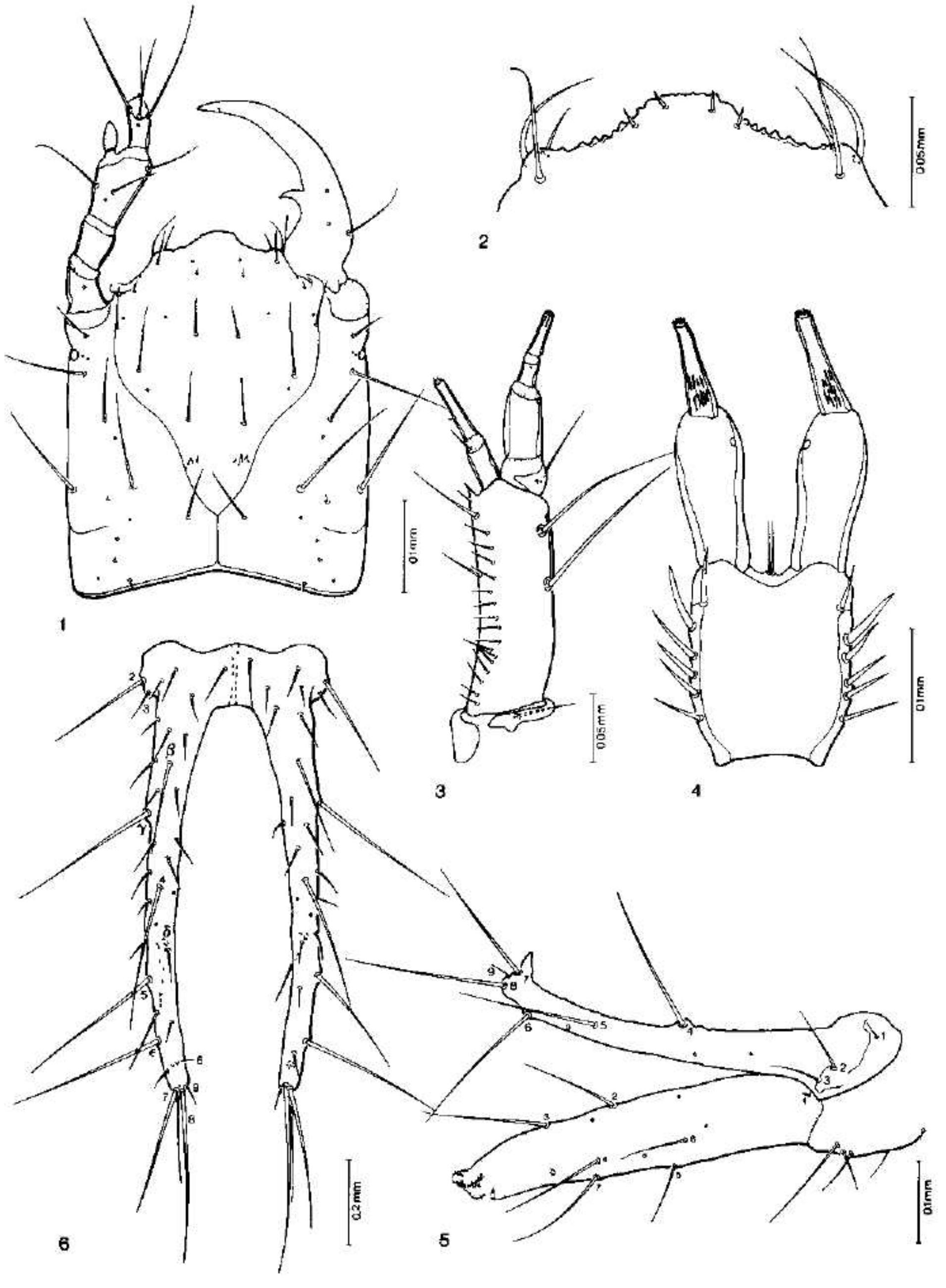
Microsculpture. Head without distinct pattern of microsculpture. Pronotum without microsculpture. Meso- and metanota with weak, multipointed microsculpture over anterior fourth of posterodiscal area. Tergites 1-8 with weak, mostly multipointed microsculpture over most of posterodiscal area. Tergite 9 with pointed, in part multipointed, microsculpture. Urogomphi with wart–like microsculpture. Pygidium with wart-like microsculpture.

Head. Cephalic capsule subquadrate, without basal constriction (Fig. 1). Nasale (Fig. 2) slightly protruding, its apical margin more or less truncate, without any projections or protuberances; egg-bursters consisting of 2–4 microspinulae transversally arranged on each side at base of frontale; frontal suture sinuate in posterior half; coronal suture relatively long, subequal in length to antennomere 4. Parietale with one ocellus on each side (Fig. 9) (see „Remarks" section); cervical groove present, extending laterally up to level of seta PA_{12}. Length of antennomere 1 about 1.4× that of antennomeres 2 and 4, and about 0.7× that of antennomere 3; sensorial appendage on antennomere 3 somewhat elongate. Mandible falciform; penicillus present, unisetose (Fig. 8); retinaculum simple, with posterior edge smooth; terebra with medial margin finely serrulate (Fig. 7). Maxilla (Fig. 3) with stipes about 2.5× longer than wide, without distinct membranous notch laterally or ventrally; lacinia distinct, consisting of small, acuminate cone; length of galeomere 1 about 0.8× that of galeomere 2, length of maxillary palpomere 2 about 2.2 × that of palpomere 3, about 1.2× that of palpomere 4. Prementum (Fig. 4) without ligula; length of labial palpomere 1 about 1.4× that of palpomere 2.

Thorax. Notal carina present.

Abdomen. Tergal carina present, not extended laterally. Urogomphi fixed, not segmented, relatively long, more or less parallel, with small, perpendicular process near apex (Figs 5, 10). Pygidium elongate, subequal in length to urogomphi (Fig. 5).

Legs. Tibia shorter than tarsus. Pretarsus with 2 claws, subequal in length, each with indentation near middle bearing elongate, hyaline structure (Fig. 11).



Figs 1–6 *Schizogenius lineolatus* Say. 1 - cephalic capsule, left antenna, and right mandible (dorsal view), L_1, 2 – adnasalia and nasale (dorsal view), L_1; 3 – right maxilla (dorsal view), L_1, 4 – labium (dorsal view), L_{2-3}, 5 – right urogomphus and pygidium (lateral view), L_1, 6 – ninth tergite and urogomphi (dorsal view), L_{2-3}.

Figs 7–11. *Schizogenius lineolatus* Say. 7 – terebra and retinaculum of left mandible (dorsal view), L_1; 8 – penicillus of right mandible (dorsal view), L_{2-3}; 9 – ocular area, right side (dorsal view), L_1; 10 – extremity of right urogomphus (oblique dorsal view), L_1; 11 – claws of left middle leg (lateral view), L_1.

Second and third instars

MEASUREMENT Width of cephalic capsule 0 54–0 58 mm (n=6), 0 68–0 70 mm (n=2)

COLOR Cephalic capsule yellow to brownish yellow, antennae, mandibles, and maxillae somewhat brownish, abdomen, including urogomphi, yellow to brownish yellow

CHAETOTAXY Frontale without secondary setae Parietale with several secondary setae on lateral parts Mandibles and antennae without secondary setae Stipes with one secondary, small seta posterior to MX_2, length of MX_4 0 6–0 8× that of MX_5, seta MX_6 short, 0 2–0 3× length of MX_5, located at basis of lacinia, gMX with about 15 setae Prementum with 4–5 secondary setae laterally Pro-, meso- and metanota with numerous secondary setae Tergites 1–8 with numerous secondary setae Length of seta UR_3 on tergite 9 about 0 4× that of UR_2, urogomphus (Fig 6) with 9 long setae, including 4 secondary ones (UR_β–UR_ϵ), and several small ones, seta UR_δ smaller than UR_β, UR_γ, and UR_ϵ, somewhat spine-like Median, inner, and outer sternites, hypopleurite and epipleurite on abdominal segments 1–7 with several secondary setae Pygidium with several secondary setae Femur with one pair of secondary, spine-like setae on posterior side, tibia and tarsus without secondary setae

MICROSCULPTURE Frontale without microsculpture, parietale dorsobasally with small patch on each side of irregular, somewhat transverse microsculpture Pronotum without microsculpture Meso- and metanota with pointed microsculpture mainly on lateral parts Tergites 1–8 with pointed and multipointed microsculpture over posterodiscal area Urogomphi with sparse, wart-like microsculpture on basal half Pygidium with multipointed (basal half) and wart-like microsculpture

HEAD Nasale slightly protruding, its apical margin more or less truncate to slightly rounded, frontal suture sinuate in posterior half, coronal suture relatively long, slightly longer than antennomere 4 Parietale with one ocellus on each side (see „Remarks" section), with two longitudinal sulci on each side, one ventrad, one laterad running from level of PA_9 to level of PA_6, cervical groove present, extending lateroventrally up to level of seta PA_{12} Length of antennomere 1 0 8–0 9× that of antennomere 2, 0 6–0 7× that of antennomere 3, and 1 0–1 2× that of antennomere 4, sensorial appendage on antennomere 3 somewhat elongate Mandible falciform, penicillus present, unisetose, retinaculum simple, with posterior edge smooth, terebra with medial margin finely serrulate (more or less abraded on basal half in specimens studied) Maxilla with stipes 4 4–4 7× longer than wide, without distinct membranous notch laterally or ventrally, lacinia distinct, consisting of small, acuminate cone, length of galeomere 1 about 0 9× that of galeomere 2, length of maxillary palpomere 2 about 3 0× that of palpomere 3, about 1 8× that of palpomere 4 Prementum (Fig 4) without ligula, length of labial palpomere 1 about 1 5× that of palpomere 2

THORAX Notal carina present

ABDOMEN Tergal carina present, not extended laterally Urogomphi (Fig 6) fixed, not segmented, relatively long, slightly convergent in apical half, with small, perpendicular process at apex Pygidium elongate, subequal in length to urogomphi

LEGS Tibia shorter than tarsus Pretarsus with 2 claws, subequal in length, each with indentation near middle bearing elongate, hyaline structure

REMARKS It is not clear whether or not the ocellus is functional I have not observed any pigment spot in the ocular area under the stereo microscope, using uncleared specimens

DISCUSSION

The tribe Clivinini includes about 70 genera in the World. In addition to *Schizogenius*, larvae are known for only three genera, namely *Halocoryza* (Vinson 1956), *Clivina* (Bøving 1911; van Emden 1942; Sharova, 1958, 1964; Luff 1978; Hůrka 1978; Vaněk 1984; Arndt 1991; Luff 1993), and *Dyschirius* (van Emden 1942; Sharova, 1958, 1964; Luff 1978; Hůrka 1978; Arndt 1991; Luff 1993). Unfortunately, the description by Vinson (1956) of *Halocoryza jeanneli* Vinson, 1956 (= *H. maindroni* Alluaud, 1919) is short, superficial, and does not allow comparison.

Reichardt (1977) recognized six subtribes within Scaritini (sensu lato): Pasimachina, Scaritina, Forcipatorina, Dyschiriina, Clivinina, and Salcediina. Some recent authors, such as Erwin (1991) and Bousquet & Larochelle (1993), prefer to recognize two distinct tribes, Scaritini (including Pasimachina) and Clivinini (including Forcipatorina, Dyschiriina, and Salcediina). *Schizogenius* and *Clivina* belong to the subtribe Clivinina. Larvae of both genera have reduced number of ocelli, a cervical groove on the parietale, and a unisetose penicillus. These character states are likely apomorphic for the Scaritini-Clivinini lineage. However, they occur in other, unrelated groups of Carabidae, and could be subject to convergence. *Dyschirius* and *Clivina* share the presence of a single tarsal claw, an apomorphic state that also occurs in a few other groups, such as Broscini, Bembidiini, Pogonini, and Trechini. At this time, little could be said about the classification of the Clivinini using larval characters. However, based on character states found in the three known genera, larval characters could be useful in an attempt at the classification and phylogeny of members of Clivinini.

A key to larvae of the three genera of Clivinini follows:

1. Cervical groove absent. Parietale with 6 ocelli on each side. Lacinia absent. Penicillus plurisetose. Urogomphi shorter than pygidium. .... *Dyschirius* Bonelli
– Cervical groove present, extended lateroventrally. Parietale at most with one ocellus on each side. Lacinia present as small, acuminate cone. Penicillus unisetose. Urogomphi as long as pygidium 2
2. Pretarsus with one simple claw. Urogomphus without apical process. Ligula present. .... *Clivina* Latreille
– Pretarsus with 2 incised claws. Urogomphus with perpendicular apical process. Ligula absent .... *Schizogenius* Putzeys

CONCLUDING REMARKS

The tribe Clivinini is a good example of how poorly known carabid larvae are. The group includes about 70 genera and yet larvae of only three of them have been adequately described. I hope this small contribution will stimulate others to rear, collect, and study clivinine larvae, so that eventually enough information will be available to test the current classification of Clivinini.

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BOOK REVIEW

BURKHARDT F (ed) **Mikrobiologische Diagnostik** Stuttgart-New York Georg Thieme Verlag, 1992, 831 pp Format 190×270 mm, hardcover, price DM 198 00, ISBN 3-13-743601-X

The editor is professor emeritus at the Regional Institute of Public Health (Landesuntersuchungsamt) in Erlangen This volume is organized into nine parts compiled by 58 experts, mostly university professors from western federal states of Germany, further on from Denmark, Lichtenstein and Switzerland Basic concepts of this book follow previous edition in 1974 on clinical microbiology which again was preceded by three editions dealing with bacteriology and serology As stated in the preface, during the period which has elapsed since the publication of the last edition, microbiological diagnostics has undergone remarkable developments and found its way in many branches of medicine and biological sciences Many new species of microorganisms have emerged as pathogenic agents Other organisms became opportunistic pathogens in immunocompromised patients Many new laboratory procedures have been adopted including DNA and rRNA probes and electronic data processing High level of this publication has been maintained by favorable choice of continuing contributors

Part 1 provides a general overview of the importance of pathogenic microorganisms for the human health Described here are collection, sending, disposal and evaluation of materials to be examined blood, cerebrospinal fluid and CNS tissues, ocular fluids and tissues, miscellaneous exsudates, secretions and fluids from organs and body cavities, sputum, pus, skin hairs and nails, urine, faeces and other materials

Part 2 deals with the bacteriology It is the most extensive part embracing 270 pages or approximately one third of the contents Listed here are 29 bacterial families, genera or species including the Streptococcaceae, Micrococcaceae, Neisseriaceae, gram negative rods, pathogenic vibrios, Enterobacteriaceae with 18 genera of medical importance, Legionellaceae with 29 species, *Brucella* and *Bordetella*, Pasteurellaceae, slowly growing gram negative rods, anaerobic bacteria, clostridia and corynebacteria, Bacillaceae, pathogenic aerobic actinomycetes, mycobacteria, spirochaetes, mycoplasms and other bacterial groups Particular groups of bacteria have been featured from the viewpoint of collecting and disposal of materials to be examined, microscopic identification, cultural, biochemical and chromatographic methods, antigen and toxin production, serological tests and other laboratory procedures Tests for resistance to antibiotics and other antibacterial drugs are also looked at here

Part 3 is concerned with the virology Discussed here are general biology and structure of viruses, multiplication in the host cell and transmission A review of particular viral groups follow the enteroviruses, orthoviruses, paramyxoviruses orthomyxoviruses, togaviruses, bunyaviruses and other groups The diagnostics includes cultivation and identification of viruses and antibody tests, also the modern ones – immunoblotting, DNA probes and the polymerase chain reaction

Part 4 is devoted to the mycology Described here are the dermatophytes, a large group of fungi, most of them belonging to the genera *Epidermophyton*, *Microsporum* and *Trichophyton* Further on the the zygomycetes, hyalohyphomycetes and phaeohyphomycetes with 38 genera, and blastomycetes with 12 genera These pathogenic fungi cause diseases of the skin and mucous membranes Dimorphic fungi (genera *Blastomyces*, *Paracoccidioides*, *Histoplasma*, *Coccidioides*, *Sporothrix*) are presented here as causative agents of systemic mycoses This part is concluded with a glossary of mycological terms

Part 5 is intended to give an introduction to laboratory methods for identification of three groups of protozoic parasites and helminths 1 Protozoans occurring in faeces, urine and vaginal secretions, as are enteric amoebae and flagellates, vaginal trichomonads, intestinal sporozoans and the ciliate *Balantidium coli* Among helminths there are some flukes, tapeworms and roundworm species 2 Among blood and tissue-dvelling parasites listed are the malarial plasmodia, trypanosomes, babesiae and filarial nematodes 3 Leishmaniae, pneumocysts, toxoplasms, free-living amoebae, filarial worms, echinococci, toxocara and other helminths are described here as tissue parasites

Part 6 focuses on immunology considering miscellaneous factors of nonspecific and specific defense mechanisms and antibody tests Concluding two parts provide insights into the general laboratory organization, elementary microscopy and special procedures when desribing the preparation of culture media, biochemical analyses of microorganisms, biological staining, rapid and automatized techniques, antigen identification, testing of drugs, microbiological aspects of hospital hygiene, some molecular biology methods, preparation of diagnostic sera and vaccines, and some mathematical methods In an annex laboratory safety precautions, important reagents, indicators and solutions, and useful adresses are given

This volume is extensively illustrated by 236 pictorial groups composed of 354 partly coloured figures presenting schematic line drawings, diagrams, macrophotographs of miscellaneous bacterial colonies, light and electron microphotographs and schemes of laboratory procedures Moreover, there are 192 tabular reviews of microorganisms, identification keys, syndromes and clinical pictures, and epidemiological data As reference material, this attractively produced book will also be of extraordinary use for biologists, microbiologists, parasitologists, epidemiologists and immunologists of various profiles

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Carabid communities in two biotopes of the Marano lagoon (Italy) (Coleoptera: Carabidae)

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Abstract. Two habitats of the Marano lagoon (north Italy) were sampled by means of pitfall traps to study the carabid beetle species harboured by a reed and a shelf site. The analysis of data showed that two carabid groupings characterize the sampled sites. The reed community is the more species rich, with sets of species showing heterogeneous ecological requirements. The shelf grouping is very poor in species, but it harbours only species tied to brackish environments. Differences between the two carabid groupings were also revealed in the period of activity of the species, showing the reed phenogram an autumn peak and the shelf assemblage a dominance of spring activity.

Assemblages, marsh, soil salinity, flood tide, human disturbance, Coleoptera, Carabidae, Palaearctic Region

INTRODUCTION

The investigation of the carabid groupings of humid environments is quite difficult to be performed because of the great diversity of ecological niches characterizing these habitats. This holds true mainly for lagoons, where freshwater and seashore ecosystems are strictly in contact.

General topics on carabid assemblages in marine littoral zones has been outlined firstly by Verdier & Quizel (1951), while Thiele (1977) gives a short synthesis for freshwater. A lot of works, carried on in many European countries, followed these studies (e. g.: Heydemann 1962, Obrtel 1972). In Italy, the Venice lagoon got more attention than the Marano one (see Ratti, 1979, 1981, 1983). So, we gathered here original data collected in the years 1984/85 for a contribution to the knowledge of carabid groupings of the latter brackish water environment, not only from the faunistic point of view, but also from the ecological one.

We are honoured to give this contribution for the „Festschrift" of Prof. Karel Hůrka, to whom this paper is dedicated.

MATERIAL AND METHODS

The Marano lagoon is near the town of Grado, in the northern coast of the Adriatic sea. Two sample sites, a reedy habitat and a shelf island, were chosen along its inland border, 1 km apart from the sea (Figs. 1 and 2).

The reedy sample site was a small island very close to the dry land, joined to it by manmade reed covered small bridges, rising almost 1 m above water level, and it was often inundated. It was colonized mainly by *Phragmites* (80%) and other bushy plants, growing on silty or muddy soil.

The shelf sample site was a smaller island rising 20–30 cm above water level, and very often inundated according to the floodtide. It was covered for the 40% by bushy and grass vegetation, that grew on sand-muddy soil saturated by water for the most part of the year. This site was periodically disturbed by dumping of dredged sediments to clean the adjacent shipchannel.

Samples were collected by means of pit-fall traps, i. e., plastic vessels (9 cm mouth diameter, 7.5 cm base diameter, 11 cm depth) containing 200cc of an attracting-preserving mixture of wine vinegar with 5% formalin. Traps were placed in number

of five per site and emptied monthly from May 1984 to January 1985. The collections in each sample site were quantified as annual Activity Density (aAD) as follows:

$$aAD = \frac{\text{total specimens captured}}{US}$$

where

$$US = \sum_{j=1}^{m} [\,\text{traps} \times \text{days}/10\,]_j$$

with m = number of sampling periods in each site during the year.

RESULTS

Analysis and rearrangements of data are summarized in Tab. 1, in which information on some biological features of the collected species is also given. As it is clearly shown by the table, two groups of species, differing both under the qualitative (species composition) and quantitative (annual Activity Density) point of view, characterize the sampled sites.

Only four species are present in both sites. The presence among them of *Pterostichus melanarius* with very low aAD in shelf site, but not in reed site, where only one species is more abundant than it, is probably due to the wider habitat affinity of this eurytopic, manmade habitat tied beetle. *Dicheirotrichus obsoletus* behaves in the opposite way, being the dominant species in shelf site, but showing very low aAD in reed site. *Bembidion iricolor* and *Agonum duftschmidi* has low aAD in the two sites. Among these four species it is likely that *B. iricolor* and *D. obsoletus* affect only in a marginal way the carabid assemblages of inland reedy habitats because of their ecological preference (halobiont species).

From the known literature (in particular, Brandmayr & Seriani 1981, Contarini & Garagnani 1981, Ratti 1979, 1981, 1983, 1984, 1986) we took the informations for Tab. 2, where a description of the two carabid groupings is synthesized by means of ecological and biogeographical features of the collected species.

Fig. 1. The location of the Marano lagoon.

Considering the halophily as an index of the „link" with marine environment, the halophilous and halobiont species account for 19% of the collected species in the reed site, while for 62% in the shelf site. This difference is more evident if we focus on dominance of these species, that in the reed site accounts for only 1.9% of the collected individuals (listed as 2.0% in Table 2), while in the shelf site it accounts for nearly all (98%) of the individuals. These figures give evidence for a difference between the carabid groupings owed to different habitat affinity of the species composing them.

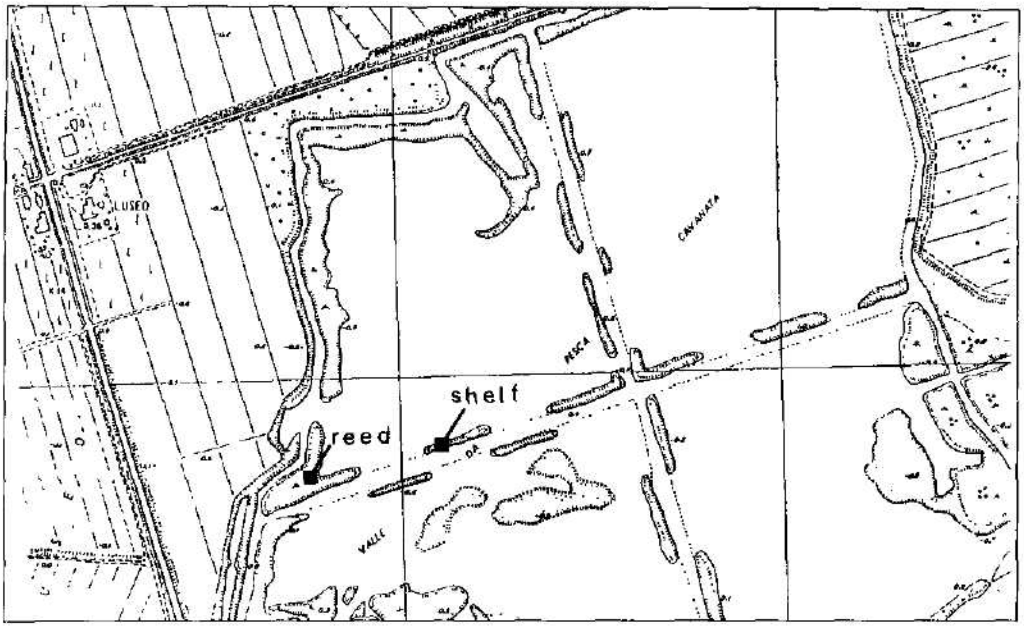

Fig. 2. Sample site location. The shipway near the shelf site is man-made.

To generalize, in the shelf site there are mainly species tied to brackish environment, directly affected by the sea influence (the sole halobionts account for 50% of the species), and they are also the dominant species. The reed site harbours a group of species almost indifferent to soil salinity and with wider ecological tolerance, together with hygrophilous species living along the rivers that play a fundamental role within the lagoon system.

In Tab. 2 the species chorology has been grouped into two categories, i. e., species with distribution limited to the Mediterranean area, and species with European or wider distribution. No endemic (Italian peninsula-) species were collected. In the reed site wide chorology prevails as much for number of species (73%) as for their dominance (98% of the collected individuals); while Mediterranean chorology accounts only for 27% of species, with 2% of dominance. In the shelf site, the 62.5% of the spe cies has wide distribution, but it corresponds only to 2% of the collected individuals. Three species (37.5%) showed Mediterranean distribution, but they accounted for the majority of the individuals (98% dominance).

Tab. 1 Sampling results for reed and shelf. Species (2nd column) are grouped according to their ecological requirements, i. e. the habitats in which it is more usual to find them (1st column). The fifth column shows the ecological preferences of the species as follows: e = euryvalent, hygr = hygrophilous, mud = muddy soil; ter = thermophilous; xer = xerophilous; helio = heliopilous; haloph = halophilous; halob = halobiont, ps = psammophilous. Brackets are used in case of weak preference. The last c olumn shows the chorology of the species as follows. III= European species in the widest sense, where capital letter means cardinal point, m = restricted to the Mediterranean basin, IV = Eurasiatic, Eurosiberian; V = palearctic, holarctic

habitat choice		reed	shelf	ec. pref	distribut.
eurytopous fields, grasslends and open vegetal formations; also in broadleaf and riverside woods	*Pterostichus niger* Schall, 1783	4.02		e igr	IV
	Pterostichus melanarius Illiger, 1798	0.97	0 02	e (igr)	IV
	Carabus granulatus L., 1758	0.68		e igr	IV
	Badister bipustulatus Fabricius, 1792	0.03		e igr	V
	Clivina fossor L., 1758	0.01		e igr	IV
	Agonum duftschmidi Schmidt, 1994	0.01	0 02	e igr	IV
bos, riverbanks, water-meadows	*Anisodactylus binotatus* Fabricius, 1787	0.04		(igr)	IV
	Lasiotrechus discus Fabricius, 1801	0.01		igr	IV
	Pterostichus vernalis Panzer, 1796	0.05		igr	V
	Drypta dentata Rossi, 1790	0.01		igr (mud)	IV
	Bembidion quadrimaculatum (L., 1761)	0.01		igr.	V
fields and open veg. formations	*Harpalus rufipes* De Geer, 1774	0.08		ther xer	V
	Harpalus rubripes Duftschmid, 1812	0.01		ther (xer)	IV
	Calanthus cinctus Motschulsky, 1850	0 01		ther	IIIm
	Poecilus cupreus (L., 1758)	0.11		ther	IV
	Dromius linearis Olivier, 1795	0.01		ther	III Sm
clerings, grasslands and open veg. formations in sunny places	*Harpalus luteiformis* Duftschmid, 1812	0 03		helio	II
	Cicindela germanica L., 1758	0 02		helio	IV
	Bembidion properans Stephens, 1828	0.01		helio	IV
mediterranean open land	*Amara montana* Dejean, 1828	0 01			III m
seashore, bogs, *Molinia* formations	*Microlestes corticalis* Duftschmid, 1820	0 01		haloph (ps)	V
	Bradycellus distinctus Dejean, 1829	0.01		halo ps	III Wm
	Pterostichus cursor Dejean, 1828	0 03		haloph	III Nm
	Bembidion iricolor Bedel, 1879	0 03	0 03	halob	III Wm
	Dicheirotrichus obsoletus Dejean, 1829	0 03	1.92	halob mud	III Wm
	Pogonus riparius Dejean, 1828		1 17	halob mud	III Em
	Anisodactylus poeciloides Stephens, 1828		0 02	halob	III
	Oodes gracilis Villa, 1833		0.01	haloph	
	Pterostichus strenuus Panzer, 1797	0 02		igr	IV
	Platynus scrobiculatus Fabricius, 1810		0.01		
	total aAD	6.26	3.2		
	number of species	26	8		

DISCUSSION

By the help of literature information, and on the basis of our knowledge, five sets of the sampled species have been proposed in Tab. 1.

In the reed site a group of six species is tied to the agricultural landscape, from where they spread. They all have a wide ecological tolerance, that facilitate the colonization of several humid habitats. Three species show the maximum aAD, i. e., *Pterostichus melanarius*, *P. niger* and *Carabus granulatus*. It is likely that they come from the surrounding fields, but probably

Tab. 2. Importance of the halo-preference and mediterranean distribution in percentage of species and individuals in the reed and shelf sites

	Reed site		Shelf site	
	species	individuals	species	individuals
halophilous and halobiont	19%	2%	62%	98%
widedistribution	73%	98%	62%	2%
Mediterranean distribution (sensu lato)	27%	2%	37%	98%

they also inhabited the now disappeared ancient lowland forests. *Clivina fossor* and *Agonum duftschmidi* are tied to field and to open-structure vegetation habitats, but they are also well adapted to the riverside environments or water meadow-forests (especially the latter).

The second and third set of species seem to be favoured by the microclimatic conditions that characterize different part of the year.

In the second set we have grouped the species known for their hygrophily, like *Pterostichus vernalis*, *Drypta dentata* and *Bembidion quadrimaculatum*. In the lagoon they find satisfying conditions for their ecological requirements, being it a place in which deposition of slime and clay takes place, with the consequent formation of fine texture soils. They are active mainly in spring and at the beginning of the summer (see Fig. 3), then, when during the summer the temperature rises and ground water decreases, it is likely that they migrate in areas fulfilling their ecological needs.

The areas more elevated over the ground water level and with scarce vegetation cover are characterized by summer aridity. This probably explain the presence of the thermophilous and xerophilous species in the third set, i. e., *Harpalus rufipes*, *H. rubripes* and *Calathus cinctus*, that are active from august to September (see the phenogram of *H. rufipes* in Fig. 3).

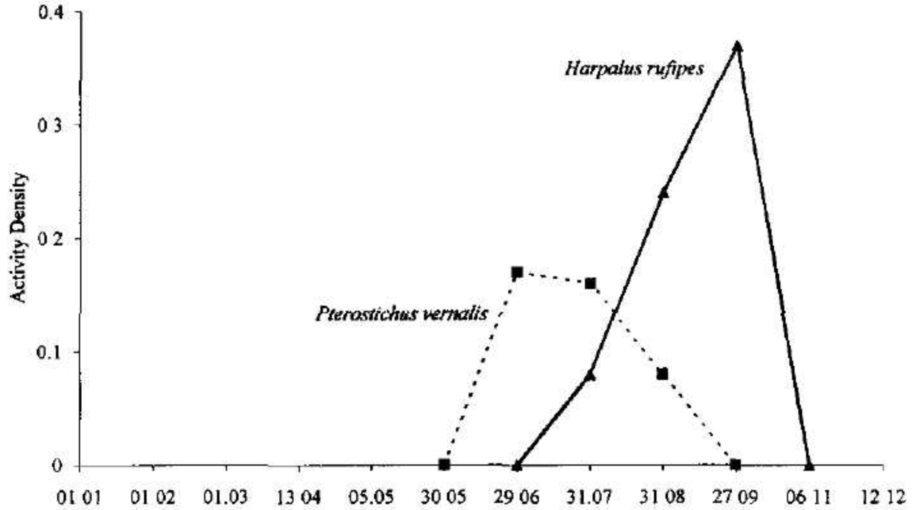

Fig. 3. The activity period of *Pterostichus vernalis* Panzer and *Harpalus rufipes* De Geer, that have different ecological preferences, mirrors the seasonal variation in the reed site.

The second and third species sets mirror the seasonal variation of the main abiotic factors, temperature and humidity, under the phenological point of view also, being the second a set of spring breeders, and the third a set of autumn breeders.

The rarefaction of vegetation cover together with soil water storage, give an explanation to presence on the lagoon banks of heliophilous species as *Harpalus luteicornis*, *Cicindela germanica* and *Bembidion quadrimaculatum*, that are found in wood clearings or in vegetation-less open land, with clayey or fine-grained soil (see table 1).

The species of the sixth set are more strictly tied to seashore or to salinity, that is the factor conditioning the presence of these species in the inland. The set of the shelf site is not so heterogeneous as for the reed site, being formed almost entirely by flying halo-requiring species, coming from coast environments. The shelf site gives favourable conditions particularly to *Dicheirotrichus obsoletus*, sporadically found also in the reed site, and *Pogonus riparius*, exclusively found in the shelf site. The only not halo-requiring species found in the shelf site are *P. melanarius* and *Agonum duftschmidi*, captured there during their seasonal peak of activity. The shelf environments show a particular lagoon feature, in which the species grouping is strongly affected by soil salinity and warmhumid microclimatic conditions. It is to be noted the instability of this carabid grouping, owed to the floodtide that frequently cause a complete abandonment of the colonized shelves.

The difference between reed and shelf carabid groupings is evident taking into account also the carabid seasonal activity in the sites (see Fig. 4).

The phenogram for the reed site is mainly depending on the activity of *P. niger* and *P. melanarius*, autumn breeders, accounting for the 79% of the captured individuals. The other species have low aAD, they are mainly spring breeders, as *Carabus granulatus*, that for a large part is responsible for the second peak in the phenogram of Fig. 4.

Summer seems to be the unfavourable season for the shelf site. The peak of carabid activity is in spring, when the emerging of the adults of the dominant species takes places. During the

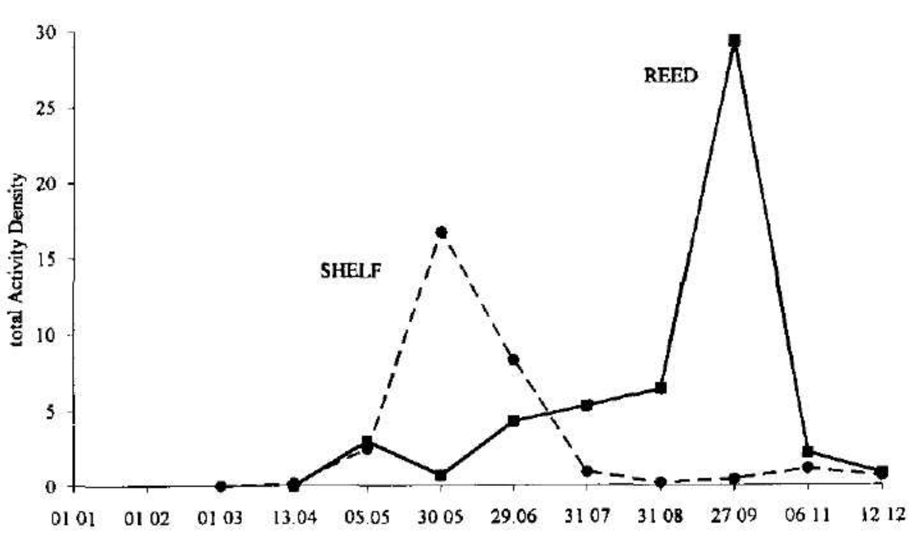

Fig. 4. Carabid seasonal activity in the sampled sites.

summer the low and scattered vegetation is insufficient to regulate the microclimate draught and high temperature. Only in the autumn a second peak takes places, but the carabid activity is hampered by the ground water rise, as a consequence of the increased river flow typical for this season.

The presence of *Platynus scrobiculatus*, species of the upland forests, and of *P. strenuus*, montane species tied to humid broadleaf woods, is probably due to accidental river downloading, as suggested by Ratti (1986) for the Venice lagoon (last species group in Table 1).

CONCLUSIONS

The sampled sites harbour two different carabid groupings, as it has been found by the qualitative and the quantitative data (aAD, chorology, phenology) analysis. It could be suggested that their species composition is at widescale affected by the oceanic/continental features of the climate, while at the niche level a fundamental role is played by soil salinity.

The reed site, and probably all the inland banks of the lagoon, harbours a group of species that seems to be the result of an „intersection" among different sets of species coming from the environments surrounding the lagoon. The species of wetmeadow forests, dwelling also in the fields, showed to be the dominant or abundant species in the reed site, they play the role of historical indicators (Brandmayr & Pizzolotto 1988, Pizzolotto & Brandmayr 1990), inherited from the ancient lowland landscape, n ow disappeared as a consequence of the agricultural exploitation. Anyway, some species more typical of reed swamps could'nt have been captured by pitfalls.

The shelf site carabid grouping is the only harbouring typical species of the marshy and brackish biotopes. The main ecological factors influencing this environment are the temperate climate, with strong sun influence, and the flood tide. The absence of species as *Cicindela trisignata* (Latreille et Dejean, 1822) and *Clivina ypsilon* (Dejean, 1831) and perhaps of other *Dicheirotrichus* Duval, 1857 spp. should be interpreted as the consequence of a strong anthropic disturbance (sediment dumping). This species grouping is to be related to the first steps of the shelf colonization

It is likely that almost the same species, with similar quantitative relationships, be present in lagoon shelf environments, as general feature of them. If we consider a carabid community as an assemblage of species definable on a faunistic (list of species) and statistical (the „weight" of each species) basis, correlated with definite bioclimatic factors (Pizzolotto 1994), then we can say that data from the shelf site give a picture of some important features characterizing the carabid community(ies) of shelf environments, where *Dicheirotrichus obsoletus* and *Pogonus riparius* are the leading species.

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Life history and pre-imaginal stages of *Dromius meridionalis* (Coleoptera: Carabidae: Dromiini) in Sardinia

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Abstract. Adults and larvae of *Dromius meridionalis* Dejean, 1825 were collected throughout the year with corrugated cardboard „trapping-bands" on lime-trees (*Tilia platyphyllos*) at Sassari (Sardinia, Italy). The larval and pupal characters of this trunk-dwelling, undercanopy species are described and discussed. Its life cycle displays a summer breeder element. Its prey is identified as Lepidoptera larvae from the Pyralidae and Oecophoridae families.

Pre-imaginal stages, life history, Coleoptera, Carabidae, Dromiini, *Dromius meridionalis*, Palaearctic region

INTRODUCTION

Many Carabidae species are currently described as „arboreal" beetles, often trunk-dwelling, undercanopy or canopy specialists, in tropical forests (Erwin 1979a), whereas in the temperate regions of the Holarctics Carabidae are normally identified as true „ground-beetles" (Laufkäfer – running beetles – in the German literature) (Thiele 1977), though many species, often waterside generalists or lowland dwellers in unstable environments, have retained a winged or pteripolymorphic condition (Brandmayr 1991, Boer et al. 1980), and a high ability to disperse by flying. There are, however, several winged Carabidae species in these regions that usually complete part or the whole of their life cycle on or under the bark and on the foliage of plants of different species and sizes. In Europe and throughout the Mediterranean area, these are nearly all Lebiinae (sensu latissimo: Casale et al. 1982, Basilewsky 1984) (= Lebiini of other authors). Lebiini and Dromiini (excluding Lionychina), in particular, are often arboreal beetles (see for example Burmeister (1939) and Jeannel (1942). For this very reason, however, carabidologists are unfamiliar with many of their species, since they are accustomed to collecting insects under stones and dead trees, or in pit-traps. Arboreal species, therefore, are more often collected by those who specialise in phytophagous insects.

The life history and cycle of several Lebiina and Dromiina are unknown. In Europe, Silvestri (1904) was the first to illustrate the hypermetabolic cycle of *Lebia scapularis* (Fourcroy, 1785) and its association with the leaf beetle *Galerucella luteola* (O. F. Müller, 1766). Lindroth (1971) has discussed possible instances of Batesian mimicry of Chrysomelidae by Lebiinae.

In tropical forests, Erwin (1979b) and Erwin & Erwin (1976) have described highly interesting, sometimes parasitoid adaptive specializations in arboreal Carabidae. Much fresh information concerning these climbing and flying insects will undoubtedly be provided by further investigation of their place in canopy environments.

The present paper is a contribution to the knowledge of the immature stages and life cycle of *Dromius meridionalis* Dejean, 1825, a common Euro-Mediterranean, arboreal Dromiina species.

MATERIALS AND METHODS

During a long-term investigation of phytophagous insects in a lime-tree (*Tilia platyphyllos*) avenue in the city of Sassari (Sardinia, Italy), several larvae and adult specimens of Carabidae were collected with corrugated cardboard trap bands fastened round the trunks about 3 m about from the ground Specimens were found in the spring (April 19, and May 3 and 10, 1995), autumn (November 3, 16 and 29, 1995) and winter (January 9, and March 8, 1996) Only adults were present from May to July

The adults and some larvae were preserved in 70% ethanol. The remaining larvae were bred in glass capsules at 22 °C They accepted no food in autumn and spring. Pupae were obtained in April 1995 from hibernating larvae, whereas the larvae collected in autumn did not breed

Three pupae were preserved in 70% ethanol Five Dromius meridionalis adults were obtained from the others One pupa (not described) was smaller and displayed highly different chaetotaxic characters It was probably a *Philorhizus crucifer*, since this species is common on the local *Tilia*.

Drawings were made with a stereomicroscope Wild M5 and microscope Leitz Dialux 20 EB.

RESULTS

Pre-imaginal stages

Egg

No eggs were obtained. Several years ago, however, one of the present authors (A.C.) identified some *D. meridionalis* adults collected by Bin on Monte Peglia (500–600 m, Province of Perugia, central Italy), where two egg-cases attributed to *Dromius* Bonelli, 1810 (*D. meridionalis* or *D. quadrimaculatus* (L , 1758)) were observed in autumn on two Gypsy Moth (*Lymantria dispar* L., 1758) egg-masses on oak trees and described by Bin (1980) as made of „a waxy material completely wrapping the egg, thinner on the ventral than the basal side" , 1 mm long × 0.5 mm wide, with a thin, virtually smooth chorion. From the eggs, Bin obtained adults of *Xenomerus ergenna* Walker (Hymenoptera: Scelionidae, of the Xenomerini tribe, a specialized group of egg parasitoids associated with Carabidae).

3rd-instar larva

The terms used are taken from Böving (1911), Bousquet & Goulet (1984) and Giachino (1989).

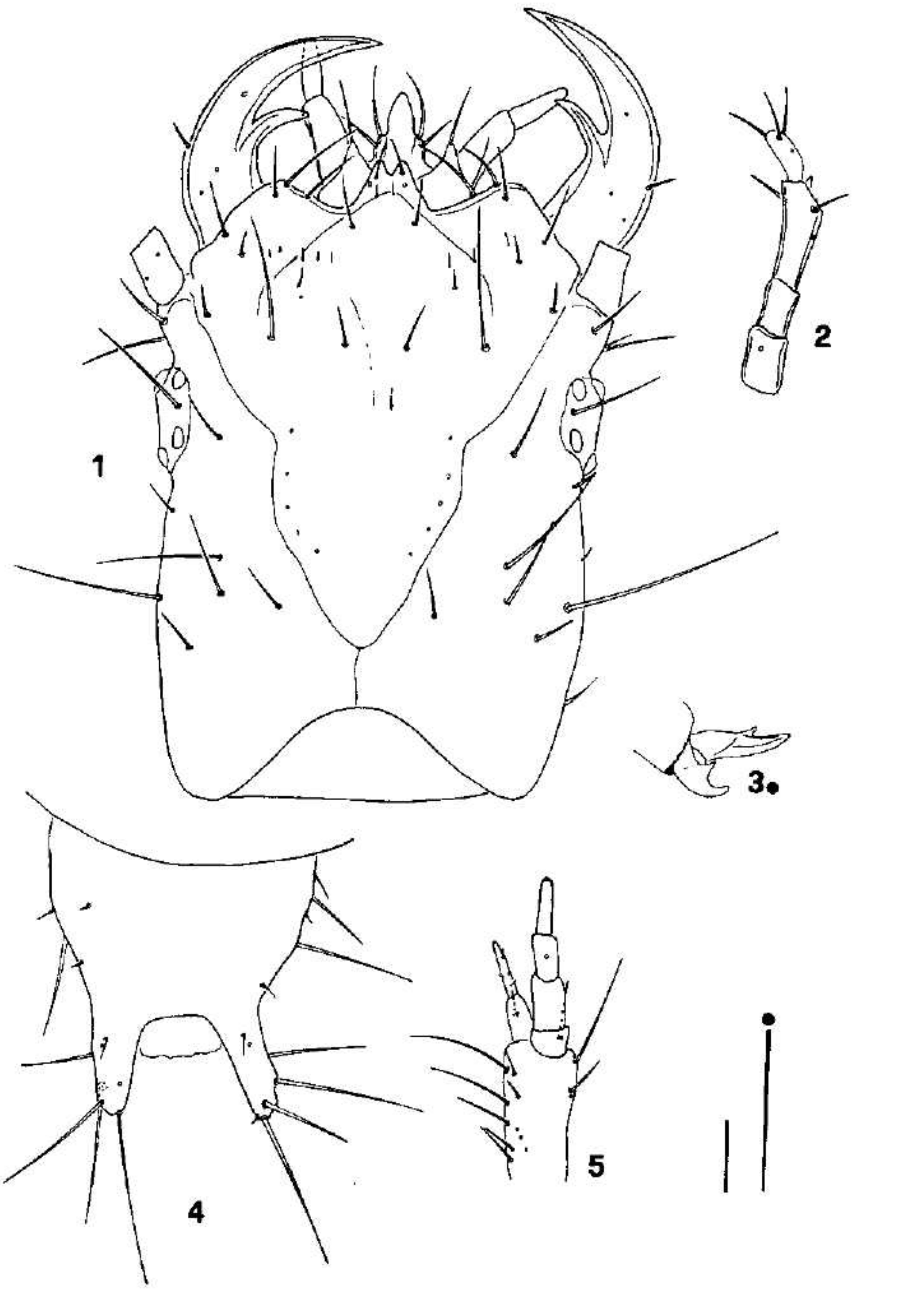
Larva bicuspid, from pale to darker brown, dark red-brown head. Length: 5.9–7.5 mm from apex of mandible to apex of urogomphi, excluding the macrochaetes.

HEAD (Fig. 1). Elongated, L/l ratio 1.48. Frontale sutures clearly visible, bent back, sinuous and almost angular at the centre. Metopic suture perfectly distinguishable along about one-tenth of the clypeus-cervix distance. Chaetotaxy of the cephalic region shown in fig. 1. Setae FR_2 and FR_3 located well forward (almost at the insertion of the antennae). Straight row of 4–6 small setae running from FR_6 to the centre of the frontale.

Anterior edge of the epistoma („nasale"): trilobate. Distinctly protruding side lobes, with subrectilineal, forward-converging side lobes bearing two dorsal setae, one long (FR_7), the other shorter (FR_4), incised, but rounded, at the median lobe, where there is also a seta (FR_5) about as long as FR_6. Central lobe protruding well beyond the side lobes and formed of two subacuminate, symmetric, subtriangular teeth separated by a distinct, deep V-shape groove. FR_{10} and FR_{11} set well forward, with FR_{11} very long.

Eye area, prominent, with six stemmata and two setae. Parietale lacks PA_1, PA_2 and PA_3.

Antennae (Fig. 2): short, about the same length as the mandibles, or a little less (a/M ratio 1.06). First, second, third antennomeres subcylindrical, second and third almost imperceptibly dilated at the apex, fourth cylindrical and subtruncated at the apex. Third antennomere nearly twice as long as the first. Chaetotaxy as proposed by Bousquet & Goulet (1984), except for the absence of AN_1. Distinctly and markedly squamous antennal microsculpture.



Figs 1–5. *Dromius meridionalis* Dejean, mature larva, morphology: head in dorsal view (1), right antenna in dorsal view (2), arsal claw (3), telson in dorsal view (4), right maxilla in dorsal view (5). Scale: 0.1 mm.

Mandibles very arcuate, with strong retinaculum and almost smooth inner edge, external marginal seta (MN_1) located before the half-length point

Maxillae (Fig 5) distinctly longer than the mandibles (m/M ratio 1 23) Large, stubby stipes, slightly dilated distally, 6–7 masticatory setae (gMX), with well-developed MX_5 Galea with second segment distinctly longer than the first First segment of the maxillary palpi short and subquadrate, second and third subequal and decidedly longer, fourth about a third longer than the third

Lower labium decidedly trilobate, with setae LA_4 at the apex of the side lobes Central lobe with evident and very prominent membranous lobe, at whose sides setae LA6 are in an abnormal position and preceded by setae LA_5 in a very advanced position No setae on the palpi of two segments First segment distinctly longer than the second

PRONOTUM Lateral series of 5–7 setae and pores not directly referable to the pupal setae

LEGS Long, relatively robust Trochanter, femur, tibia and tarsus with lengthwise rows of setae Chaetotaxy similar to that proposed by Jeannel (1942) and Bousquet & Goulet (1984) Finely denticulate tarsal claws (Fig 3) different in size, unlike those of *D agilis* (Fabricius, 1787) as described by Jeannel (1942 fig 339f)

Telson (Fig 4) with two strong, short urogomphi, salient and well separated from the base Chaetotaxy similar to that proposed by Bousquet & Goulet (1984)

Pupa

Whitish, translucent, eyes, pronotum, and apex of mandibles darker, brownish in the more mature specimens Pupa exarata with free appendages, body elongated and depressed (Figs 6–7) Total length 5 5 mm

HEAD Hypognathous (Fig 6), general characters as in the adult, but with a peculiar chaetotaxy four long setae on vertex, inserted on conical tubercles, six setae near the anterior margin of frons, one seta (corresponding to the posterior supraorbital seta) on the inner proximal side of each eye, and two setae close to the anterior margin of the clypeus

PRONOTUM highly transverse, width/length ratio 1 5 Row of 6 long setae inserted on prominent tubercles on each lateral side of the theca covering the underlying adult pronotum One anterior and two basal setae on each side, also on tubercles The entire surface of the disk is densely punctate and finely pubescent, the median groove is wide, whitish and glabrous

Mesonotum with two lateral (one large, one smaller) and one small posteromedian seta on each side Two small spots of very short pubescence near the middle Metanotum same, but without these spots

Pterothecae short and arcuate Legs, in the podothecae, with finely denticulate claws, as in the adult

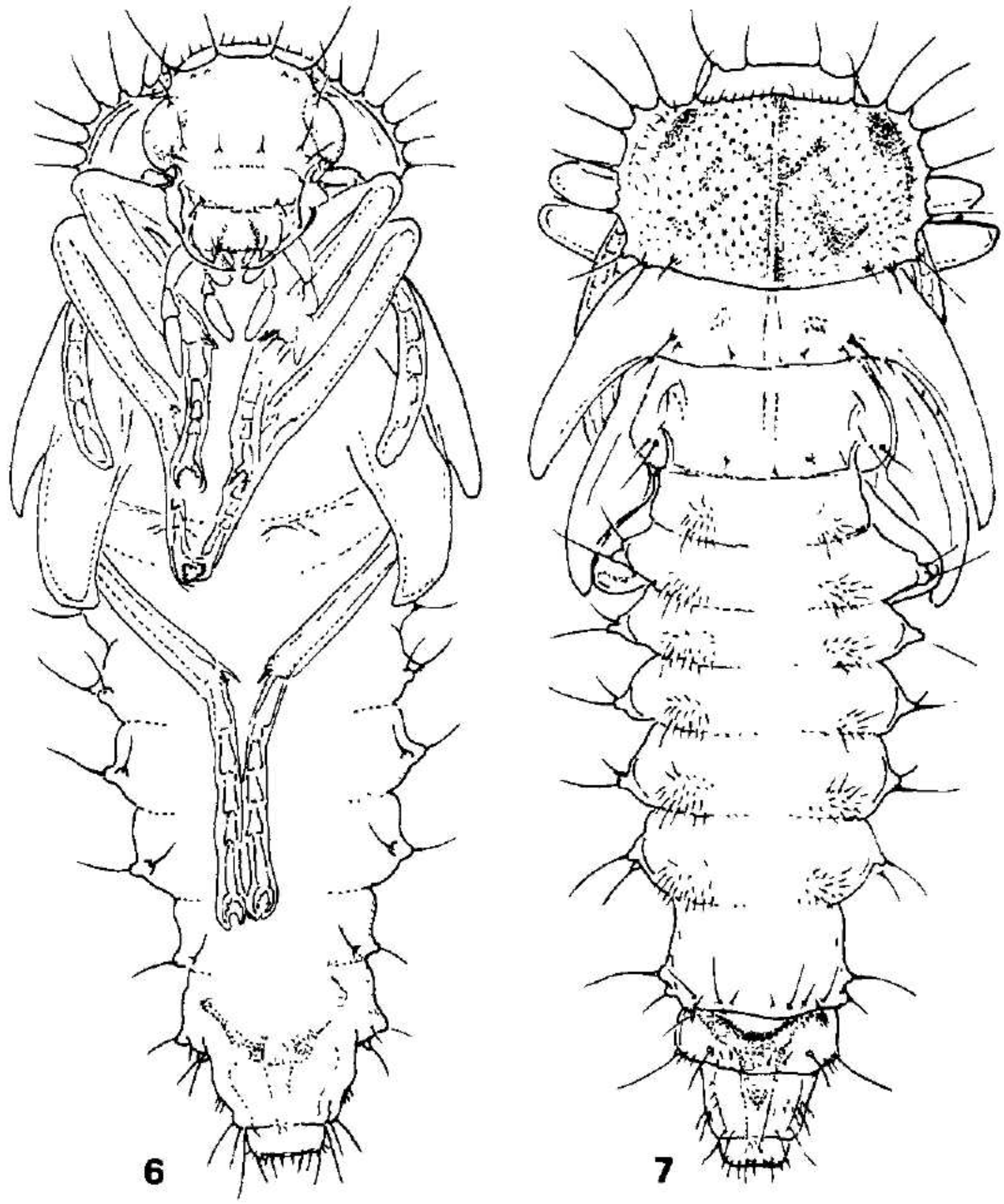
ABDOMEN Tergites I–VI with posterolateral brush of long, erected hairs on each side Tergites VII and VIII with row of long setae along the posterior side Tergites from II to VIII with 2 long lateroventral setae on each side, inserted on large, subconical pleural protuberances No cerci

Life cycle (Fig 8)

Our adult and larva collection times and laboratory breeding data show that in northern Sardinia *D meridionalis* is a summer breeder with larval (and adult) dormancy (Hůrka 1986) This cycle is probably the same as that of other species of arboreal mediterranean Dromiina Conversely, the larva of North American species *Dromius piceus* Dejean, 1825, living on white and red oaks and jack pine, pupate in August – September (Mahar et al 1983)

In natural conditions, therefore, they evidently feed and breed under the bark and in canopy of living trees

Adults emerge at the end of April or beginning of May and disperse by flying and climbing on trees. In June and July, they were collected on the trees where the larvae completed their cycle. In summer and autumn, isolated flying specimens were collected by night at the black light.



6 7

Figs 6–7 *Dromius meridionalis* Dejean, pupa, ventral side (6), dorsal side (7) Length 5 5 mm

Eggs are laid on the bark in summer (sometimes on supports, such as egg-masses of *Lymantria dispar* see above, and Bin (1980)) Parasitized eggs have been found in late autumn (Bin 1980) L dispar, however, is rare or absent on this *Tilia* avenue and eggs are probably laid in bark fissures or moss on the trunks No eggs, in fact, were found

It cannot yet be determined whether adults breed in their first summer or only after the winter dormancy, or both Larvae evidently complete their entire cycle on the trees, since these flank an avenue with heavy foot and wheeled traffic, and their bases are surrounded by concrete and stones with no room for suitable vegetation

Absence of the earliest instars in summer and early autumn, is probably due to their preying on Lepidoptera larvae on branches and foliage In November, mature, 3rd-instar larvae (in Dromiina, the cycle is a normal one composed of three instars) sheltered under the bands with the adults to hibernate Their diapause, like that of the adults, may be interrupted or irregular One larva, in fact, and some adults, were collected in January from under bands applied monthly They had stopped feeding, all larvae taken in autumn and winter died without metamorphosis

In March – April, larvae and adults begin to be active The larva do not eat and metamorphose In nature, they probably look for a sheltered fissure and scales in the bark or trunk in which to pupate In the laboratory, adults appeared in 12–14 days 17–24 April to 3–6 May, and 24–26 April to 6–7 May

Food

On finding *Dromius* (probably *D meridionalis*) egg-cases on *Lymantria dispar* egg-masses, Bin (1980) suggested that this oviposition „could be casual, but the formation of an egg-case, regarded as a form of parental care, and possibly also the place chosen for egg laying could be closely related to the diet of larvae Therefore, larvae of Dromius sp could be predators of the Gypsy Moth eggs, or newly hatched larvae" As already stated, *L dispar* is rare on the Sassari lime-trees, whereas adults and larv ae of D meridionalis (and other Lebiinae, see section Associated Carabidae) are rather abundant The only food available is the plentiful larvae of two small moths *Ephestia elutella pterogrisella* Roesler (Pyralidae, Phicitinae) and *Denisia* sp (Oecophoridae) Several of their larvae were collected in the company of *Dromius* larvae and adults, and adults were obtained in March and April from hibernating larvae

It cannot yet be shown whether *D meridionalis* larvae or adults prey on eggs or newly hatched larvae of a so large moth as *L dispar*, whose the newly hatched larva is he same size as the mature *Dromius* larva and becomes many times larger in a few days The observation of *D meridionalis* egg-cases and oviposition on L dispar egg-masses could thus be a simple, although very interesting, shelter form for the eggs, without any parental care

Associated Carabidae

We also found the following Lebiinae species *Philorhizus crucifer crucifer* (Lucas, 1846) (the most common, in all seasons), *Calodromius bifasciatus* (Dejean, 1825) (7 August 1 specimen, 27 October 1 specimen), *Paradromius linearis* (Olivier, 1785) (28 July 1 specimen, 12 October 1 specimen), and *Lebia scapularis* (Fourcroy, 1785) (2 June 1 specimen)

There was also a single specimen of *Phyla tethys* (Netolitsky, 1926) (6 October), a winged species of Bembidiini very common in Sardinia, the occurrence of which is certainly casual Also the presence of *P linearis*, too, is rather unusual in these „arboreal" conditions, since it is normally riparian, common on sandy shores along rivers and marshes, often on or near *Carex* spp and *Phragmites* aquatic plants

DISCUSSION AND CONCLUDING REMARKS

In Europe and the Mediterranean Region, Dromiina (sensu stricto, excluding Lionychina, which are terrestrial, sandy dwellers both as adults and larvae) are represented by some genera, with several species more or less adapted to live in vegetation.

Four genera in particular are close to each other:

1) *Paradromius* Fowler, 1886, with *P. linearis* and *P. longiceps* (Dejean, 1826), both tied to moist environments, along rivers and marshes, sometimes climbing on aquatic plants. Eggs are laid in the soil and larvae are terrestrial (Jeannel 1942).

2) *Philorhizus* Hope, 1838 (sensu stricto – Sciaky (1990)), with several „arboreal", widespread species, together with four (*P. mendizabali* Mateu & Colas, 1954, *P. paulo* Wrase, 1995, *P. liguricus* Sciaky, 1990 and *P. brandmayri* Sciaky, 1990) from Spain and Italy that are brachypterous, terrestrial and all steno-endemic to small mountain areas.

3) *Calodromius* Reitter, 1905, with two species in Italy (Vigna Taglianti 1993) both living in vegetation.

4) *Dromius* with several species (five in Italy: Vigna Taglianti 1993), all winged and normally associated with arboreal plants, in both lowland and in highland forests.

As mentioned in the Introduction, Dromiini have been observed several times on trunks and foliage. Some species (Habu 1967 ex Hicks, Casale, 1983) have been collected in bird's nests. Jeannel (1942) lists scolytid beetles as possible preys of *D. marginellus* Fabricius, 1794 (= *D. schneideri* Crotch, 1870).

Burmeister (1939) and Jeannel (1942 ex Perris) report larvae and adult specimens of *Calodromius spilotus* (Illiger, 1798) (= *C. quadrinotatus* Panzer, 1801) feeding on young larvae of the weevil *Pissodes notatus* (Fabricius, 1787).

Bisio (1996) has found large numbers of adults of several *Dromius* and *Philorhizus* species hibernating under the bark of living trees at a rather high altitude in the Western Alps.

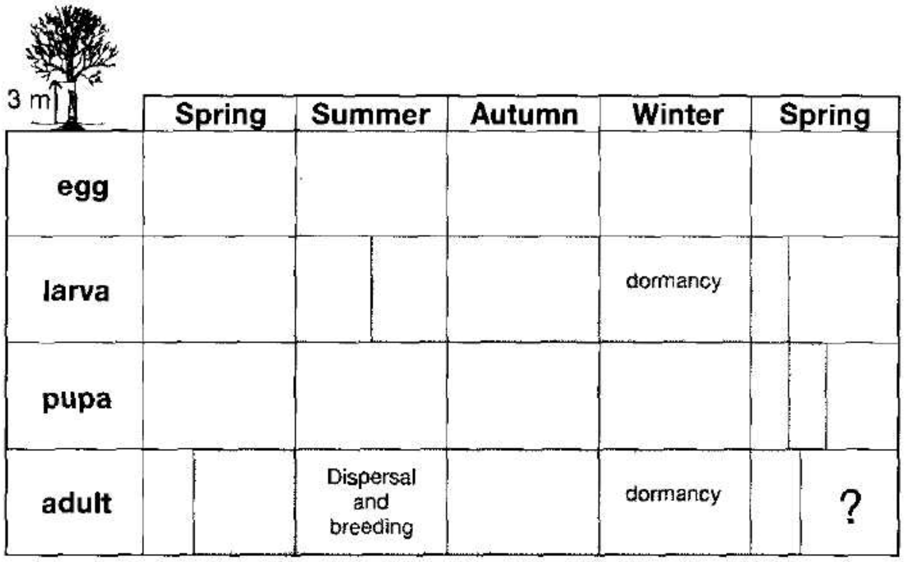


Fig. 8. Reconstructed life cycle in northern Sardinia (Italy) of *Dromius meridionalis* Dejean, an under-canopy, trunk dweller carabid beetle.

This study of *D. meridionalis* has shown that :
1) it is a developmental type with larval dormancy;
2) it has a poorly specialized way of life, since it can also colonize cultivated trees along avenues in the heart of a city;
3) it may prey on Lepidoptera larvae from the Pyralidae (*Ephestia elutella pterogrisella* Roesler) and Oecophoridae (*Denisia* sp.). Predation on moth larvae from various families has been demonstrated several times for the Lebiinae, for example *Calleidina* (Andrewes 1933, Habu 1967, Zhou & Goyer 1993).

A more varied diet (larvae of xylophagous, subcorticolous beetles) seems not impossible, in our opinion, for the more generalist species. The xylophagous Scolytidae or Curculionidae reported as possible preys of other Dromiini, however, were not found on the Sassari lime-trees.

The larval morphological characters were in line with those illustrated for other European *Dromius* species (Jeannel 1942 ex Schiödte, van Emden 1942, Sharova 1958).

The tarsal claws of mature *D. linearis* larvae are toothed and peculiarly asymmetrical. In D. piceus, two ventral teeth on each claw are present (Mahar et al. 1983).

The pupa of *D. meridionalis* is described for the first time in this paper. It displays several peculiar features compared with another obtained from another (not bred) larva, which probably belonged to *Philorhizus crucifer*.

As several authors have remarked, the pupal morphology of carabid beetles is so poorly known because the complete development of many species is very difficult to achieve in the laboratory.

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We thanks Dr I Manca (Sassari) for his help in the elaboration of figures of the life cycle and Dr G Bassi (Torino) for the identification of associated Lepidoptera

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BOOK REVIEW

GOTTSCHALK W **Allgemeine Genetik. 4th revised and extended edition** Stuttgart-New York Georg Thieme Verlag, 1994, 424 pp Format 120×190 mm, softcover, price DM 98 00, ISBN 3–13–508904–5

The author is a professor emeritus and director at the Institute of Genetics of the University in Bonn (Germany) Previous editions of this book occurred in print in 1978 (a reprint in 1982 – also translations in Japanese and Spanish), further on in *1984* and in *1989* As stated in the preface, last decades have seen major advances in the field of molecular genetics and the gene physiology Today, it is hardly possible to embrace the whole range of genetics in a single volume Thus, the subjects of classical genetics are generally treated only in a very limited frame The reader might get a distorted idea that the classical genetics represents a closed field of scientific activity However, this idea is incorrect It is to be emphasized that modern molecular genetics is built up on classical genetics and both scientific branches are closely interlaced In the introduction listed are basic biological disciplines the knowledge of which for genetics essential is - the cytology, karyology, biochemistry, physiology, microbiology, cultivation of plants and animals, and biometry From plant and animal experiments conclusions may be drawn to the human genetics The volume consists of 13 chapters

The introductory chapter deals with prokaryotes and eukaryotes as subjects of genetic investigations In the chapter 2 analyzed are the cellular basis of genetics, the asexual and sexual types of reproduction, exchange of generations, nuclear division – mitosis and meiosis, sporeformation, the effect of mutagenes, and genetic regulation of meiosis In the chapter 3 genetic materials, genes and cistrons, chemical structure of genes, DNA replication, transformation, transduction and transposition, and chromosomes and the genome are examined Chapter 4 focuses on the influence of external environment upon the genotype and phenotype modifications Chapter 5 is devoted to general laws in classical genetics – to Mendelian principles *of inheritance and genetic terms when discussing genetic linkage, intrachromosomal recombination, gene location*, pre- and postreduction, inheritance related to sex, and miscellaneous gene functions In chapter 6 discussed are the gene, chromosome and genome mutations, mechanisms of mutagenic effects and DNA repair Following four chapters provide insights into fundamental principles of evolution, sex determination, extrachromosomal inheritance, genetic regulation of biosynthesis, and transcription and translation as principal steps for protein biosynthesis Chapter 12 covers the regulation of gene activity in prokaryotes and eukaryotes Concluding chapter 13 gives an overview of methods used in genetic manipulations, gene isolation and cloning, integration of eukaryotic genes into prokaryotic systems, transgenic organisms, and genome manipulations (genetic engineering) in mammals

This book is based on a continuing tradition of four editions and international translations within 16 years It is illustrated by 120 figures composed of 262 line drawings and photographs These figures present the chromosomes, phases of mitosis biological cycles in organisms with different chromosome equipment, diagrammatic representation of genetic maps, production of germinal cells, modelled structures and schemes of genetic processes and procedures In addition, there are 13 tables summarizing miscellaneous genetic phenomena and abnormalities This successful text has a practical pocket format – it offers in a slight dimension and in an easy-to-follow language a good amount of principal and up-dated informations on classical genetics

Jindřich Jíra

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Description of the first instar larva of *Thalassophilus longicornis* (Coleoptera: Carabidae: Trechodina)

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Abstract. The first instar larva of *Thalassophilus longicornis* (Sturm, 1825) is described, representing the second species of Trechodina known in the larval stage. A preliminary diagnosis of the genus *Thalassophilus* Wollaston, 1854 on the basis of larval features is given. Lack of the lacinia, pores PR_c, PR_e, PR_h, PR_j on the pronotum, ME_d, ME_e on the meso- and metanotum, seta ES_1 on the metanotum and pore TE_b on all abdominal tergites in *Thalassophilus* are typical features for all known Trechitae larvae. On the other hand two unequal claws with a very long single claw seta, absence of the pore PA_b on parietale, setae EM_1 on meso- and metanotum, seta EP_1 on ninth abdominal segment and some other unique larval features within Trechitae show the isolated position of *T. longicornis* within all other known Trechitae larvae.

Larva, description, morphology, Coleoptera, Carabidae, Trechodina, *Thalassophilus*, Palaearctic region

INTRODUCTION

The group of the subtribes Perileptina, Trechina and Trechodina is, from a taxonomic viewpoint, one of the most intricate within the Carabidae. Undoubtedly, these taxa are more related to each other, than to other Trechitae tribes known in the larval stage (Bembidiini, Tachyini, Pogonini) and some authors consider them as a large tribe Trechini (s. l.) (Jeannel 1926, Kryzhanovskij 1983). Phylogenetic relationships between these three groups are treated by various specialists in different ways, as discussed by Belousov & Kabak (1993).

The subtribe Trechodina occur „gondwanienne indo-africano-australo-malgache, avec un genre (*Thalassophilus*) emirge en Europe ou la limite nord de son aire a été remaniee par le Glaciaire" (Jeannel 1926). Now some new interesting data have been published Trechodina from Russian Far East (Moravec & Wrase 1995, Ueno et al. 1995). Very little has been published about the larvae of Trechodina and the third instar larva have been described only of *Amblystogenium pacificum* (Putzey, 1870) (larva was originally described as *A. murcipenne* Enderlein, 1905) (Drygalski 1909, Womersley 1937, Jeannel 1941). This taxon was included by van Emden (1942) in his study of Carabidae larvae.

MATERIAL AND METHODS

This study is based on a single raised ex ovo first instar larva of *Thalassophilus longicornis*. Adults were collected by the author on April 14, 1995, on the sand-alluvial beach of the middle course of the Belaja River (West Caucasus). The larva was obtained on May 26 and fixed on May 28.

The larva was mounted on a permanent microscope slide with Fora-Berlese liquid and studied under a light stereo microscope at 200 or 900×. Notation of the primary setae and pores follows Bousquet & Goulet (1984). An asterisk (*) after a number means that the homology of the seta is uncertain. The larva is deposited in the author's collection.

For comparison larvae of the following taxa were studied: Bembidiini (45 spp genera *Bembidion* Latreille, 1802 and *Asaphidion* Des Gozis, 1886), Tachyini (7 spp genera *Tachys* Stephens, 1829, *Paratachys* Casey, 1918, *Elaphropus* Motschulsky, 1839, *Porotachys* Netolitzky, 1914 and *Tachyta* Kirby, 1837), Pogonini (10 spp ,. genera *Cardioderus* Dejean, 1829, *Pogonus* Nicolai, 1822 and *Pogonistes* Chaudoir, 1870), Trechini (12 spp · genera *Trechus* Clairville, 1806, *Aepus* Samouelle, *1819* and *Epaphius* Stephens, *1827*) (first instar larvae of the tribe Trechini were studied only for *Epaphius secalis* (Paykull, 1790) and *Aepus robini* (Laboulbene, 1849).

RESULTS

Description of the first instar larva of *Thalassophilus longicornis* Sturm, 1825

Habitus (Fig. 1). Larva slightly sclerotized, very slight; tergites without keels; main part of setae longer than in usual Trechitae larvae.

Cephalic capsule (Figs 2, 3) subquadrate (width 0.30 mm, length 0.29 mm); flat, parallel-sided anteriorly and slightly convergent posteriorly; ocellar tubercules, ocelli, postocellar and cervical grooves absent; egg-bursters and teeth-like or pointed microsculpture on head absent; epicranial suture long (ratio epicranial suture length / head length 0,18); frontal suture slightly covered; apical part of frontale wide and less protruding; nasale (Fig. 8) less protruding, with two rows of teeth anteriorly.

Microsculpture on parietale transverse; covering all of parietale (including near seta PA_9, and lateral and ventral surfaces); shape of parietal microsculpture equal dorsally, ventrally, and laterally; frontale with transverse microsculpture in basal part (at base of setae FR_2 and FR_3); frontale along medial line smooth, without microsculpture; clypeus with slightly developed transverse microsculpture.

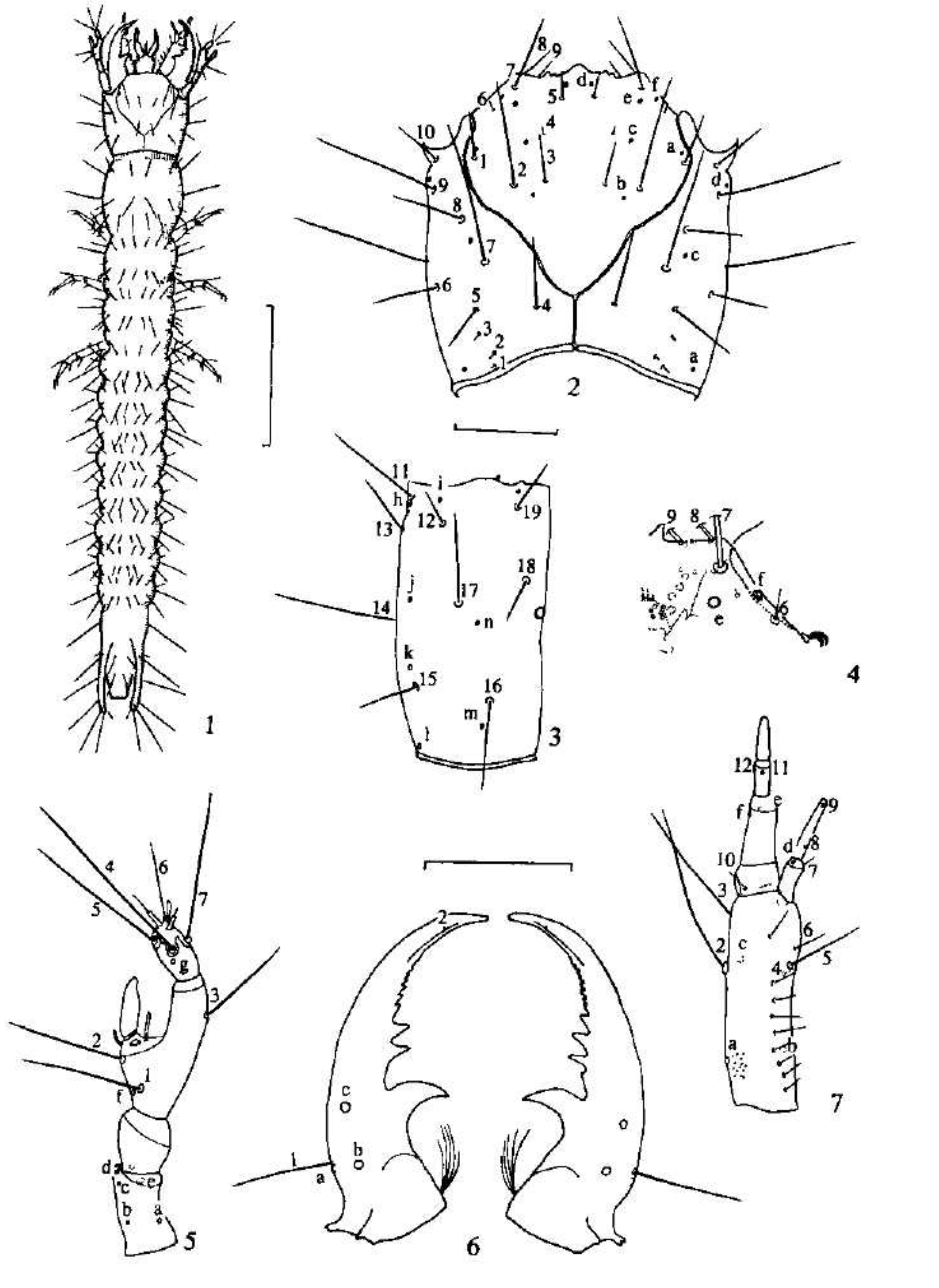
Chaetotaxy of cephalic capsule. all primary setae and pores (except PA_b) present; additional sensilla absent; length of seta PA_3 = 0.5 length PA_1; length of setae PA_4 and PA_{10} = 0.6–0.8 length PA_7; setae PA_7 and PA_{14} longest on head; distance $PA_n - PA_{16}$ = 3× distance $PA_n - PA_{17}$, setae FR_1 and FR_3 long, subequal to PA_5 and = 0.5 length FR_2; setae FR_1 and FR_2 not together, distance $FR_2 - FR_3$ = 1.5× distance $RF_1 - FR_2$ and = 2× distance $FR_3 - FR_3$; pore FR_b and seta FR_3 drawn to gether, distance from frontal suture to FR_b = 2.5× distance $FR_b - FR_3$; seta FR_4 very small, subequal to seta FR_6, pore FR_c and seta FR_5 drawn together; length of seta FR_4 = 0.3 length FR_5; setae FR_4 and FR_5 not draw together, distance $FR_4 - FR_4$ = 2× distance $FR_5 - FR_5$; pore FR_e at level of pore FR_f; seta FR_6 at margin of frontale; ventral surface of paraclypeus with two small setae on each side (Fig. 4); small sensillum between pores FR_8 and FR_9 present; seta FR_{10} longer then FR_{11}, anterior angles of hypopharynx with 12 round sensilla on each side (Fig. 4).

Appendages of head with all primary setae and pores; without additional sensilla.

Antenna (Fig. 5): proportions of articles 1.6:1.3:3.0:1.3; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomeres 3 and 4 well developed; both bell-like sensilla on antennomere 3 long (ratio length / width 4–6); sensorial appendage on antennomere 3 very elongated, as long as antennomere 4; all three basiconical sensilla of antennomere 4 dorsal and very long.

Mandibles (Fig. 6) slightly covered; retinaculum perpendicular; penicillum not extended to retinaculum; terebra with 2–3 larger and 9–12 smaller teeth; dorsal keel slightly developed, dorsal surface near pore MN_b smooth, without teeth.

Maxillae (Fig. 7): cardo without teeth; stipes narrow (ratio length / width 3.5); without large teeth on base; with 12–15 small teeth of microsculpture at level MX_a; dorsal side fully sclerotized, without membranous surface; pore MX_c slightly apical to MX_2; group gMX with 9–11 setae; apical seta of this group beyond level of MX_6; other setae of gMX basally level of MX_4; seta MX_6 small, its length = 0.5 length of MX_5; seta MX_4 small, its apex not extending to inner



Figs 1–7. First instar larva of *Thalassophilus longicornis* (Sturm). 1 – general view. 2 – cephalic capsule (dorsal view). 3 – cephalic capsule (ventral view). 4 – right anterior angle of frontale. 5 – left antenna. 6 – mandibles. 7 – left maxilla. Notation of the primary setae and pores follows Bousquet & Goulet (1984). Scale bars: Fig. 1 – 0.5 mm; Figs 2, 3 – 0.1 mm; Figs 5, 6, 7 – 0.1 mm.

margin of s tipes; galea long, its length = 2/3 length of maxillary palp; length of galeomere 1 = 0.5 length of galeomere 2; galeomere 2 very narrow (ratio length / width 9); seta MX_7 small, no longer than width of galeomere 2; seta MX_8 in proximal quarter of galeomere 2; seta MX_9 situated at top of galeomere 2; proportions of maxillary palpomeres 1:2:1:1, setae MX_{11} and MX_{12} very small, no longer than 0.1 width of palpomere 3; palpomere 4 normal, not divided into secondary sclerites.

Labium (Fig. 9) with very small teeth on lateral sides of dorsal surface; ligula protruding, not sclerotized (Fig. 10); palpomere 2 normal, not divided into secondary joints; seta LA_2 long, extending to apex of palpomere 1; setae LA_3 and LA_4 small, subequal in width to base of palpomere 1; seta LA_5 on dorsal side of ligula; setae LA_5 and LA_6 flat, not extending to apex of palpomere 1.

Thorax (Fig. 13): transverse microsculpture developed only on pretergites of meso- and metanotum; additional sensilla absent.

Pronotum with all primary setae and pores (except PR_c, PR_e, PR_i, PR_j, and ?PS_2); setae PR_4, PR_{12} and PR_{14} subequal to each other; seta PR_{10} removed basally; seta PR_7 comparatively long, subequal to 4 diameters of seta PR_6 at base; pore PR_f beyond to level of PR_8; episternites, epimerites and sternites of pronotum with all primary setae and pores.

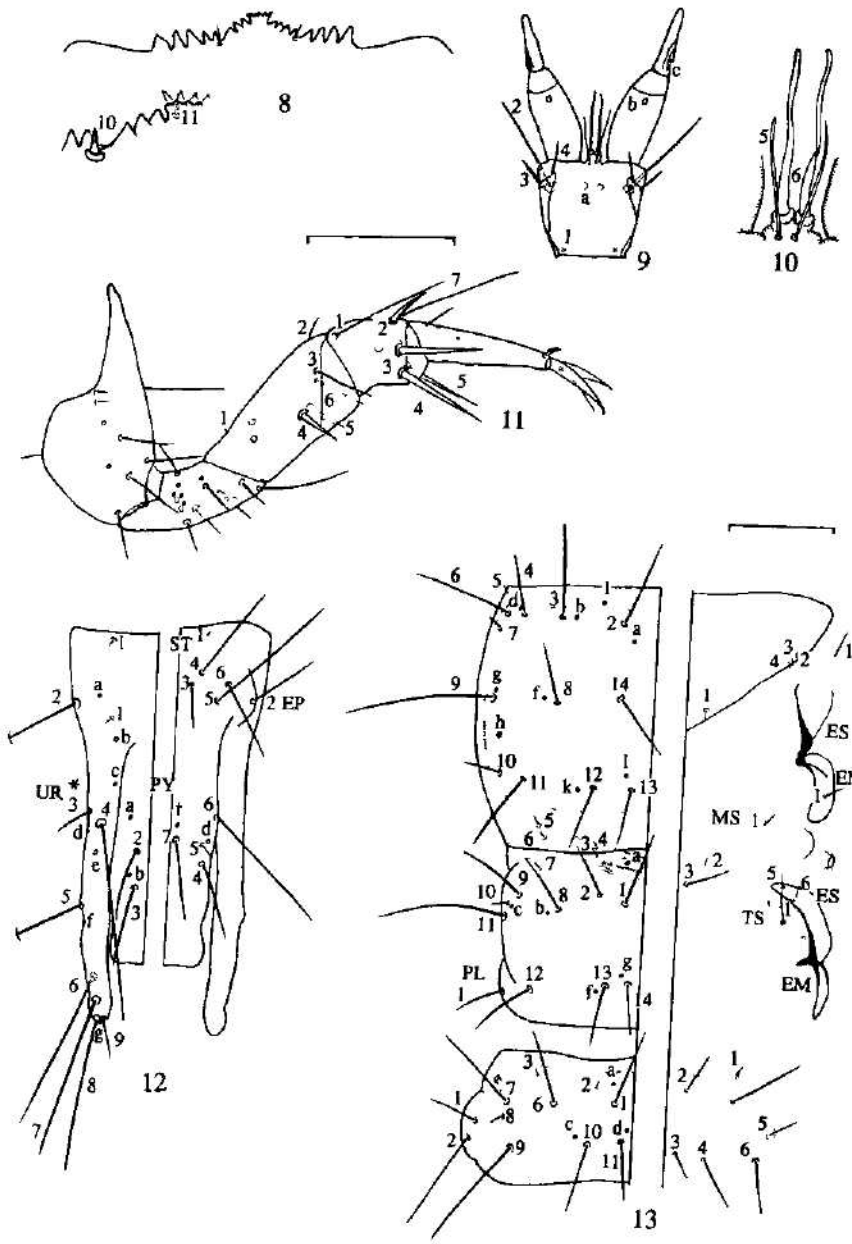
Meso- and metanotum with all primary setae and pores on tergites (except pores ME_d and ME_e); setae ME_{10} on meso- and metanotum comparatively long, subequal to 3 diameters of seta ME_{11} at base; length of seta ME_{14} = 0.8 length ME_{13}; setae ME_{13}, ME_{14} and pores ME_g, ME_f removed to medial line; lateral and ventral surfaces of meso- and metatorax with setae ST_5, ST_6, PL_1, TS_1, MS_1, MS_2, MS_3, MS_5, MS_6; setae ES_1, EM_1, and ?MS_4 absent.

Legs (Fig. 11): with two unequal claws (anterior claw longer than posterior one); with a single claw seta subequal to posterior claw; all other articles with all primary setae and pores, without additional sensilla; seta TA_1 in proximal one-sixth of tarsus; tibia short; setae TI_1 and TI_7 very thin and long; setae TI_2, TI_3, TI_4, TI_5, and TI_6 thick and short; setae TI_4 and TI_5 longer than TI_2, TI_3, and TI_6; seta FE_1 very small; length of seta FE_2 = 3× length FE_1; setae FE_3 and FR_6 thin and long; setae FE_4 and FE_5 thick and short; seta TR_6 long, subequal to TR_7.

Abdomen (Figs 12, 13): first abdominal segment with all primary setae and pores (except pore TE_b and one setae of ST_5 or ST_6), without additional sensilla; segments 2–8 with all primary setae and pores (except setae TE_4, TE_5 and pore TE_b), segments 2–7 with one additional seta on median sclerites on each side; eigth segment without additional setae; length of seta TE_{11} = 0.9 length TE_{10}; setae TE_9 comparatively long, subequal to 3 diameters of seta TE_{10} at base; tergites 1–8 smooth, without microsculpture, base of urogomphi and dorsal side of pygidium with slightly developed pointed microsculpture; urogomphi (Fig. 12) thin and straight; their length = 1.2 length of pygidium; urogomphi and pygidium with all primary setae and pores (except EP_1 on ninth abdominal segment); sternal sclerite of ninth abdominal segment with a single unsymmetrical additional seta on left side; seta UR_3* near UR_4; setae UR_3* and UR_9 comparatively long, their length = 2× width of apex of urogom phi; seta PY_6 long, extending to apex of pygidium.

Preliminary larval diagnosis of the genus *Thalassophilus* Wollaston, 1854

Within the supertribe Trechitae (sensu Kryzhanovskij 1983) only the larva of *Thalassophilus longicornis* is characterized by: egg-bursters and teeth-like or pointed microsculpture on the head absent; transverse microsculpture on parietale covering all the sclerites (including place near seta PA_9, lateral and ventral surfaces); shape of transverse microsculpture subequal on all surface of parietale; pore PA_b absent; sensorial appendage on antennomere 3 very elongate (ratio le ngth / width 3.5); seta MX_8 in proximal quarter of galeomere 2; galea very long, its length



Figs 8–13 First instar larva of *Thalassophilus longicornis* (Sturm) 8 – nasale 9 – labium 10 – ligula 11 – leg 12 – urogomphi and pygidium (dorsal and ventral view) 13 – pronotum, mesonotum and fourth abdominal segment (dorsal and ventral view) Notation of the primary setae and pores follows Bousquet & Goulet (1984) Scale bars Figs 9, 11 – 0 1 mm, Figs 12, 13 – 0 1 mm

0.6 length of maxillary palp; galeomere 2 very narrow (ratio length / width 9); setae ME_{13}, ME_{14} and pores ME_6, ME_8 removed to median line; setae EM_f on meso- and metanotum absent; legs with two unequal claws; single claw seta very long; abdominal segments 2–7 with one additional seta on median sclerite on each side; seta EP_1 on ninth abdominal segment absent; seta UR_3* near UR_4. Additionally, the larva of *Thalassophilus longicornis* is distinguishable from all Trechini larvae known to me by the normal maxillary palpomere 4 and labial palpomere 2, which are no divided into secondary sclerites.

DISCUSSION

The lack of lacinia, pores PR_c, PR_e, PR_i, PR_j on pronotum, ME_d, ME_e on meso- and metanotum, seta ES_1 on metanotum and pore TE_b on all abdominal tergites of *Thalassophilus* are typical features for all Trechitae larvae known to me.

It is possible to distinguish three main groups of the features of the first instar larva of *Thalassophilus longicornis*:

1. The adaptive features: slightly sclerotized and very slight body; tergites without keels; all setae more long than usual for Trechitae larvae; cephalic capsule flat, parallel-sided; ocellar tubercules, ocelli, post-ocellar and cervical grooves absent; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomere 3 and 4 well developed; both bell-like sensilla on antennomere 3 long; sensorial appendage on antennomere 3 very long and narrow, as long as antennomere 4; dorsal side of stipes fully sclerotized, without membranous surface. All these features are more or less developed within all other Trechitae larvae with a special way of life (main part of Trechini; some Bembidiini (sg. *Synechostictus* Motschulsky, 1864 and *Pseudolimnaeum* Kraatz, 1888 of the genus *Bembidion*)).

Is is possible that the absence of egg-bursters and teeth-like or pointed microsculpture on the head; the absence of small teeth on dorsal surface of mandible near pore MN_b and the very narrow joints of maxillae (particularly the galeomere 2) are also adaptive features.

2. The features, sometimes marked within other Trechitae taxa: pore FR_e removed to level of pore FR_6; setae TI_1 and TI_7 very thin and long (*Aepus robini*); terebra with large teeth (*Porotachys bisulcatus* (Nicolai, 1822), *Paratachys* spp.); maxillary palpomere 4 and labial palpomere 2 normal, not divided into secondary joints, (Bembidiini, Tachyini, Pogonini); setae LA_5 and LA_6 flat (sg. *Synechostictus* and *Pseudolimnaeum* of the genus *Bembidion*); seta ES_1 on mesonotum absent (*Aepus robini*).

3. Unique features within the supertribe Trechitae: lacking of pore PA_b on parietale, setae EM_1 on meso- and metanotum and EP_1 on ninth abdominal segment; seta MX_8 in proximal quarter of galeomere 2; abdominal segments 2–7 with one additional seta on each side of median sclerite; seta UR_3* on urogomphi near UR_4.

Presence of two unequal claws with single long claw seta is of a great interest. The main part of so far known Trechitae larvae have one claw with one short claw seta. Larvae of *Perileptus areolatus* (Creutzer, 1799) (Perileptina) have two claws equal to each other with two long flat claw setae (Boldori 1936, Luff 1985). Larvae of *Amblystogenium pacificum* (Trechodina) have „the tarsus ends in two claws, one being slightly longer than other" (Womersley 1937). It is not possible now to mark one of these states as apomorphic or plesimorphic.

Lack of the setae PS_2 on pronotum and MS_4 on meso- and metanotum is a very remarkable feature. Usually, the set of setae on the ventral surface of the thorax is very constant. These setae

are present within all Trechitae larvae known to me, but I cannot find them on the single microscopical slide It is possible that absence of these setae is only an individual aberration

A very remarkable features of seta UR_3* must be stressed Within all Trechitae larvae known to me the shape and location of the seta UR_3 is a generalized type (Bousquet & Goulet 1984) and are urogomphi without any additional setae Is the short seta on the outer side of urogomphi near UR_4 homologized to the seta UR_3 or not? Can the seta UR_3 be removed to the level UR_4 or is this seta an additional sensillum and the seta UR_3 is reduced? I do not know and I hope, that future investigation will answer this question.

Unfortunately, it is nothing known to me about way of life of *Thalassophilus* larvae The raising in the Petri-dish does not show behaviour of it But morphologically, the *Thalassophilus* larva is one of the most highly specialized of all Trechitae larvae known to me Is it microcavernicolous, intersticial or anything else? How is the morphology connected with the larval way of life? Is there any connection between the presence of two claws within Trechitae larvae and living o n sand-alluvial beaches?

From all the facts stated above, the following conclusion can be drawn The larva of *Thalassophilus longicornis* is one of the most highly specialized of all so far known larvae of Trechitae and shares a set of adaptive features, some of them unique within Trechitae larvae Besides that, there are some original features that are also marked within the other Trechitae groups There are many Trechitae taxa having still unknown larval stages. Thus the relationships between *Thalassophilus* and other Trechitae cannot be discussed now I hope, however, that these questions will stimulate carabidologists to rear and study the morphology and behaviour of Carabidae larvae, particularly Trechitae

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BOOK REVIEW

MEHLHORN H & RUTHMANN A **Allgemeine Protozoologie** Jena-Stuttgart Gustav Fischer Verlag, 1992, 335 pp Format 170×240 mm, softcover, price DM 89 00, ISBN 3–334–60390–3

The authors are professors at the University in Bochum, the first is at Chair of Special Zoology and Parasitology, the second at Chair of Cell Morphology As indicated in the preface, free-living protozoans play a major role in the food chain Parasitic forms expose to danger plants and human and animal health The volume consists of five chapters which are subdivided using the decimal system Each chapter is concluded with an extensive list of references to the primary literature

Chapter 1 is intended to give a brief introduction to the protozoa and protozoology Discussed here are the terms „protists" and „protistology" Chapter 2 presents a protozoan classification scheme embracing all of the higher-level groups Listed here are the phyla, subphyla, superclasses, classes and orders of protozoa Each systematic group is featured by a description of general morphological and biological characteristics together with a list of representative genera and species Among the subkingoom of protozoans seven phyla are recognized the Sarcomastigophora, Labyrinthomorpha, Apicomplexa (syn Sporozoa), Microspora, Ascetospora, Myxozoa and Ciliophora Principal for the human and veterinary pathology there is the class of Zoomastigophorea which comprises the trypanosomes, leishmanias, trichomonads, giardiae and some intestinal flagellates Among the class of Lobosea registered are the cystogenic amoebae *Entamoeba histolytica*, *Acanthamoeba castellanii* and *Naegleria gruberi* Cystogenic protists of uncertain systematic affiliation are also mentioned here *Blastocystis hominis* and *Pneumocystis carinii* The subclass of coccidian parasites includes the isosporans, toxoplasms, sarcocysts, cryptosporidia, plasmodia and babesiae Some representatives of the Microsporea have been recognized as opportunistic pathogens in immunocompromised patients Finally, the ciliates are looked at here

Chapter 3 is devoted to the free-living protozoans and their functional morphology to the cell membrane, cytoskeleton, cytoplasma, miscellaneous organelles and to the nucleus Other parts of this chapter discuss the multiplication, the energy exchanges and locomotion, and the role of protozoans in the ecosystems

Chapter 4 examines the parasitic protozoa Described here are the various forms of parasitism and the architecture of these organisms the cellular compartmentation, surface coat, the nucleus and various cellular organelles, cytoskeleton, the reproduction, metabolism, the ways of transmission, cryopreservation, pathogenic effects, in vitro cultivation, immune reactions against the pathogenic protozoa, diagnostic procedures and chemotherapy Chapter 5 and the appendix contain a list of textbooks and monographs and instructions for the cultivation of free-living protozoa The volume concludes with taxonomic and subject indexes

The textual information in this volume is extensively supported by 181 informative figures composed of schematic line drawings and light and electronic microscope photographs Moreover, there are five tables summarizing the chromosome structures in some parasitic protozoa, the glucose metabolism, cryoprezervation and cultivation, and selection of appropriate antiprotozoal drugs The authors offer a readable and well-arranged compendium for scientists who wish to become familiar with the taxonomy and biology of protozoa

Jindřich Jíra

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Description of the first larval instar of *Aptinus bombarda* (Coleoptera: Carabidae: Brachinini)

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Abstract. The first instar larva of *Aptinus bombarda* (Illiger, 1800) is described and illustrated. It is compared with the only other species of this genus known in larval stage, *Aptinus displosor* (Dufour, 1811). *A. bombarda* differs from this species in the larval stage by presence of egg bursting teeth, by only two pairs of setae on prementum absent, and by reduced stemmata.

Description, larval morphology, Coleoptera, Carabidae, *Aptinus*, Palaearctic region

The genus *Aptinus* Bonelli, 1810 is represented by nine species in the western part of the Palaearctic region, exactly in the northern part of the Mediterranean subregion. It is the only genus of the subtribe Aptinina represented in this region (Erwin 1970). The genus was divided in two subgenera, *Aptinus* s. str. and monotypical *Aptinidius* Jeannel, 1942 with the species *A. displosor*. The latter subgenus was synonymised with the *Aptinus* s. str. by Erwin (1970) in his reclassification of the subfamily Brachininae (given as division Brachinida).

Very little has been published about the larvae of Brachininae and mostly first instar larvae are described only. The problem is that the larvae of the species belonging to this subfamily are, as fare as it is known, ectoparasitic (Erwin 1967, Habu & Sadanaga 1969, Hůrka 1978, Bousquet 1991 etc.). The hosts or the other than first instar larvae are not known for any European species of Brachininae. The only so far known larva of genus *Aptinus* is that of *A. displosor* (Dufour, 1811) (Wautier & Viala 1967). The first instar larvae of several Palaearctic species of related genus *Brachinus* Weber, 1801 (Brachinina) were described by Emden (1942), Wautier (1963, 1964) and Habu & Sadanaga (1965) and those of genus *Pheropsophus* Solier, 1833 (Pheropsophina) by Emden (1942) and Habu & Sadanaga (1965, 1969).

MATERIAL AND METHODS

The studied larvae were reared in 1990 in the Department of Zoology, Charles University, Prague from eggs laid by captured adults. The origin of the adults was as follows: Slovakia mer., Kováčov env., (8178) 14.v.1990, O. Hovorka legit., 2 males and 1 female.

The method of rearing was as described by Hůrka (1972).

The larvae were fixed and preserved in 70% alcohol, and some were mounted in Canada balsam. The material is deposited in collection of author (five first instar larvae).

Terminology of morphology and chaetotaxy is adopted from Bousquet & Goulet (1984). The methodology of measurement of some body parts was as in Hovorka (1991).

First instar larva of *Aptinus bombarda* (Illiger, 1800)

Total length 2.1–2.2 mm; head width 0.29–0.30 mm.

COLOR. Mandibles brownish, head, pronotum and prosternite yellowish, antennae, maxillae, labium, legs, meso- and metathorax and abdomen paler.

HEAD CAPSULE (Fig. 1). Subquadrate, as long as wide or 1.1 times longer than wide. Frontal suture S-shaped, coronal suture absent. Ocular tubercle and stemmata absent, no traces of pigmentation are present. Cervical groove absent. Frontale: setae FR_1 and FR_2 large, as long as (FR_1) or longer than (FR_2) first antennal segment. Setae FR_3, FR_5, FR_{10} and FR_{11} very short, seta FR_4 pore-like. Setae FR_8 and FR_9 absent, anteriorly to seta FR_7 are present only 2 extremely small sensillae (such sensillum placed between FR_6 and FR_7 too). Pore FR_a absent. Two pairs of egg-bursting teeth are present on posterior part of frontale. Parietale: ancestral setae are present only. Setae PA_7, PA_9 and PA_{10} are largest on dorsal side of parietale, there are approximately as long as first and second antennal segments together. Other setae on dorsal, lateral and ventral parts of parietale are moderately long, longer than diameter of the first antennal segment (with exception of PA_1–PA_3 and PA_{18}).

MANDIBLE (Fig. 3). Long, slender, without penicillus. Retinaculum is small, 5–6 times shorter than width of mandibular base.

ANTENNA (Fig. 4). Without additional setae. Third antennal segment is the longest and the widest, length ratio of antennal segments 1.4:0.6:2.3:1.

MAXILLA (Fig. 5). Stipes without setal group gMX, 1.4–1.7 times longer than wide. Lacinia not entirely reduced, visible as small basolateral projection near base of seta MX_6. Galea distinctly two-segmented with distal segment very long, 2.5 – 2.8 times longer than basal segment. Seta MX_7 inserted ventrally, approximately as long as distal segment of galea. Apex of distal segment of galea bearing two additional setae and small sensillum. Maxillary palpus without additional setae, length ratio of it's segments 0.7:0.8:0.5:1.

LABIUM (Fig. 2). Prementum with only 4 primary ancestral setae on each side, setae LA_4 and LA_6 absent. Labial palpus without additional setae. Basal segment of labial palpus as long as second and 1.5–1.7 times wider than second segment, which is bearing large apical sensillum.

THORAX. Prothoracal sclerites without additional setae. Proepisternum with only 1 primary ancestral seta (ES_1). Seta PS_1 on prosternite very small, pore-like. The largest setae on pronotum are PR_6 and PR_9, which are as long as or longer than first and second antennal segments together, setae PR_2–PR_4, PR_8, PR_{10}–PR_{14} some shorter, subequal in length. Meso- and metathoracal sclerites without additional setae. The largest seta on meso- and metanotum is ME_{11}, which is approximately as long as setae PR_6 or PR_9. Legs without additional setae. Tarsus bearing only one claw, this claw without any seta (Fig. 6).

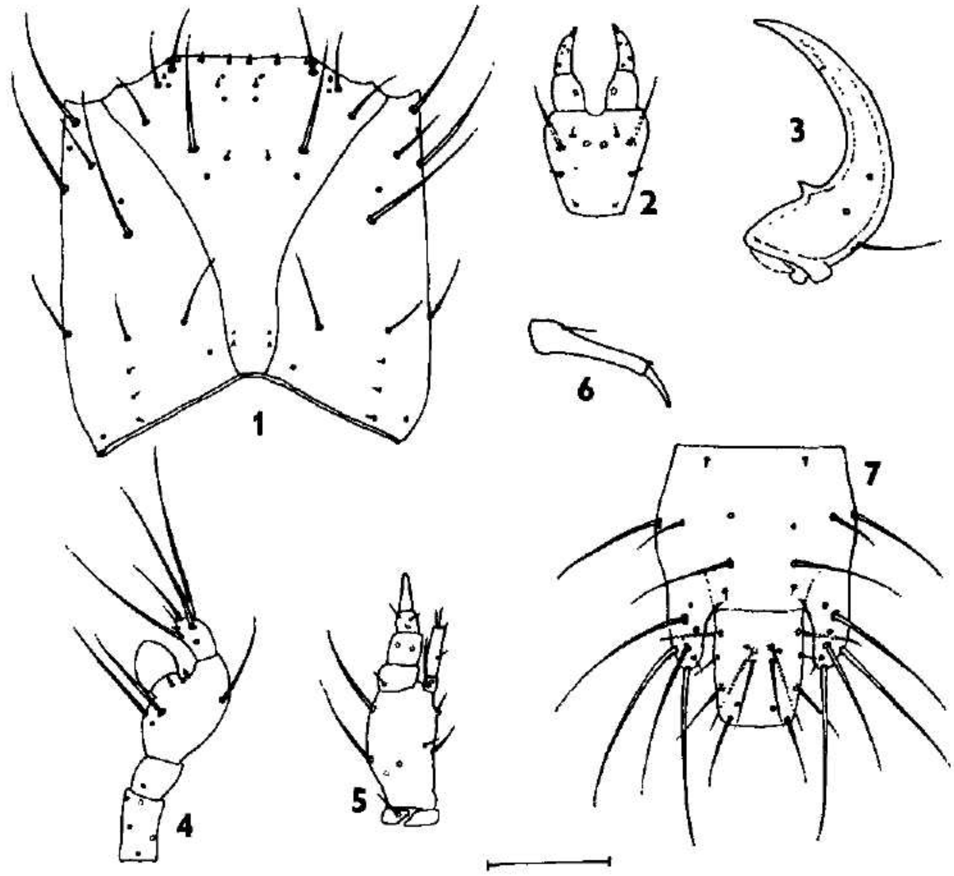
ABDOMEN. Abdominal tergites without additional setae. Setae TE_2–TE_5 and TE_8 are small, about as long as PA_1 or shorter than this seta, setae TE_1, TE_6, TE_7, TE_9–TE_{11} are moderately long. Epipleurite with both setae of equal length or the dorsoanterior seta EP_1 a little longer than EP_2. Sternal sclerites without additional setae. Urogomphi very short, only 1.3–1.5 times longer than wide, seta UR_4 inserted on ninth tergite. Sternal sclerites without additional setae.

DISCUSSION

The larva of *A. bombarda* differs from this of *A. displosor* by presence of egg bursting teeth, absence of stemmata and by presence of setae LA_3 and LA_5 on prementum (see Wautier & Viala 1967, Arndt 1991).

The paired egg-bursting teeth are unique within Brachinini (see Emden 1942, Wautier 1963, 1964, Wautier & Viala 1967, Habu & Sadanaga 1965, 1969, Hůrka 1978, Arndt 1991). There are no egg-bursters in nearest relative *A. displosor* or in any *Brachinus* species, and one unpaired egg-burster in *Pheropsophus* species. This fact seems to support the possibility of subgeneric validity of *Aptinidius*, but it is necessery to know the state of this character in other species of the genus, and, moreover to find any other, not reductional character.

The mentioned presence of seta LA_5 on prementum doesn't agree with data published by Wautier & Viala (1967) and subsequently by other authors (e. g. Arndt 1991). The absence of setae LA_4–LA_6 is by Arndt used as typical character state for genera *Aptinus* Bonelli, 1810 and



Figs 1–7. *Aptinus bombarda* (Illiger), first larval instar 1 – head capsule, dv, 2 – labium, dv, 3 – right mandible, dv, 4 – left antenna, dv, 5 – left maxilla, dv, 6 – hind tarsus, lv, 7 – ninth abdominal segment and pygidium, dv. Scale 0.1 mm (dv – dorsal view, lv – lateral view)

Brachinus Weber, 1801 I found this seta, which is small and indistinct, in all specimens of studied species and moreover on my material of larvae of *Brachinus crepitans* (Linnaeus, 1758) and *Brachinus explodens* Duftschmid, 1812

It is obvious that some details published in descriptions of the larvae of Brachinini are not exact Only next studies can bring exact data and, maybe, help us to resolv some taxonomical problems and find affinities within this unique group of carabid beetles.

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Biology and description of the larva of *Platytomus tibialis* (Coleoptera: Aphodiidae: Rhyssemina)

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Abstract. *Platytomus tibialis* (Fabricius, 1798) is mainly spread throughout the whole Mediterranean area. Biological observations were made in Southern France, in a site situated along the Rhone river. From September to May, adults remained in the soil, and their activity was reduced. Beetles were mostly active at the end of spring and in summer, and they were found at this moment under animal droppings (horses, but also cattle and sheep), where they searched for humidity. Mating and oviposition occurred in soil, consisting in a foliated mixture of sand, silt and compost. Larval development required one month. The first description of the larva of a species of the genus *Platytomus* Mulsant, 1842 is given. Larval morphological characters are very similar to those in the genus *Pleurophorus* Mulsant, 1842 of the same subtribe Rhyssemina, *sensu* Pittino & Mariani (1986).

Larval morphology, taxonomic status, ecology, Coleoptera, Aphodiidae, Psammodiini, *Platytomus tibialis*, Palaearctic region

INTRODUCTION

The genus *Platytomus* Mulsant, 1842, in its actual position within the subtribe Rhyssemina as discussed by Pittino and Mariani (1986), is widespread throughout almost the whole Mediterranean basin as well as the Australian, Nearctic and Neotropical regions. It is also sparsely occurring in western parts of the Equatorial Africa, the Mascarenes as well as in Palaearctic Asia and Oriental Asia. Ten species are actually known from the Old World (Pittino & Mariani 1986). *Platytomus tibialis* (Fabricius, 1798) is spread troughout the whole Mediterranean area, including the Atlantic Islands, and also extending across West Palaearctic Asia eastwards to Central Asia. It was also found in the Western Australia (Rakovič 1981) and in California (Pittino & Mariani 1986).

Very few data are currently known on the biology of *Platytomus* species. The Mediterranean species inhabit humid and/or arid sandy areas near the sea level to an elevetion of about 2000 m. Adults may be collected numerously by sifting sand under vegetal debris or among grass roots. At occasional occurrence, adults have been found under dried dung and stones, possibly connected with search for humidity (Pittino & Mariani 1986). Larval stages were unknown up to now.

We had the opportunity to observe during one year a large population of *Platytomus tibialis* in Southern France. The aim of the present paper is to precise the biology of both adults and larvae, and to describe the third larval stage of this species.

MATERIAL AND METHODS

Site description

The observations were carried out in Fourques (Gard Département), 2 km North of Arles, Southern France. Site consisted to a large horse enclosure lined with *Populus alba*, *Salix* sp and shrubs of *Rosa* sp Vegetation intercepted large amounts of organic matter: dead leaves, rotten trunks, and many organic debris coming from the Rhone river which flowed all along the site. The sandy bank went up slightly as far as the horse enclosure. The substratum consisted of a compact sandy silty soil, directly exposed to sun, with high seasonal variations of temperature Horse droppings were present in the whole park, but were more abundant where horses were feed *Platytomus tibialis* were only present on that part of the enclosure, and was neither present in the organic rubbish accumulated along the river banks, nor in the sandy banks

Biological observations

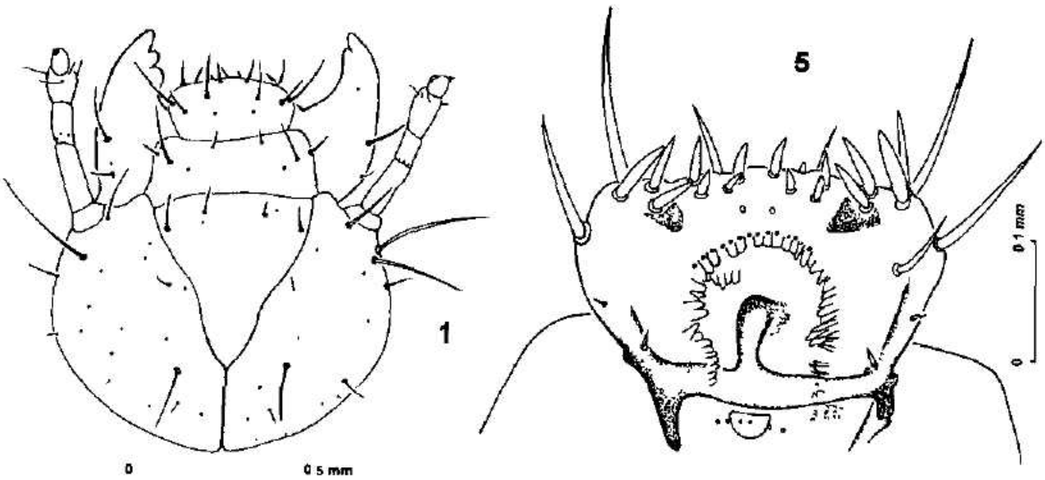
Monthly observations were made from November 1994 to September 1995. Fifteen adults were collected in February 6th 1995 and bred in the laboratory in a silty, rollen leaves and old horse dropping mixture. Larvae were obtained at the beginning of April and were fixed on April 21, 1995, in a KAAD solution (Carne 1951) when they reached the third larval stage

RESULTS

Biology

From September to May, beetles remained in the soil, consisting of a foliated mixture of sand, compost (dry horse droppings, straw, dead leaves) and silt. Beetles were distributed among the different layers, either isolated or in groups of two or three individuals, some of them in short horizontal galleries. They moved slowly when excavated, and tried to escape by digging compost. Beetles had a crepuscular and nocturnal activity. Oviposition occurred in early spring.

In May, when soil temperature increased, *P. tibialis* was very active at dusk. Beetles were found until the end of August under fresh horse droppings (about 5 individuals on average under each dropping). They exploited recent droppings, dry in surface but humid below, and always remained at the interface between the soil and the dropping. They moved horizontally but they



Figs 1, 5 *Platytomus tibialis* (Fabricius). 1 – head, 5 – epipharynx.

never made their way into dung. Larvae were never observed under horse droppings. In Morocco, *P. tibialis* was observed under cattle dung pats and sheep pellets, and possibly dung was searched by adults only for humidity rather with specialised biological requirements, as suggested by Paulian & Baraud (1982). Mating and oviposition occurred only in the foliated mixture of sand and leaves which accommodated adults from September to May.

Larval morphology

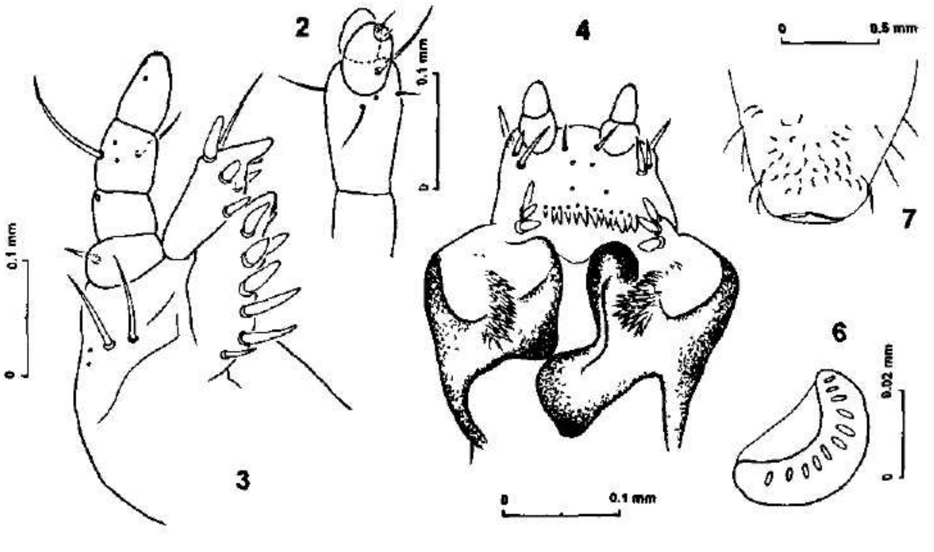
MATERIAL EXAMINED. Seven third stage larvae, obtained in April 1995 from adults kept in laboratory conditions.
ORIGIN Fourques, Southern France Material deposited in the collection of the Laboratoire de Zoogéographie, Montpellier.

DESCRIPTION. Larvae white, very small, 4.30 mm on average from the mouth parts to the anal slit. Maximum width of head capsule 0.90 to 0.91 mm (Fig. 1). Cranium yellowish brown, surface smooth, without depression on each side on the frons. Frontal suture distinc t, 12 dorsoepicranial setae and 23 microsensillae on each side. First antennal segment larger than second; second and third segments subequal. Third antennal segment with four distal setae and a large ventral apical process, nearly half long as the third segment (Fig. 2).

Frons, on each side, with 2 setae. Each antennal base with 2 long setae, one long seta dorsally and one short seta exterolaterally. Clypeus not distinctly divided into preclypeus and postclypeus. Each side of clypeus with 3 setae. Labrum with 2 central setae and 3 setae exterolaterally on each side.

Mandibles yellowish brown, with scissorial and molar area, acia and brustia dark brown. Each mandible dorsally with 2 setae and ventrally with a patch of 3 short setae (Figs 8–13).

Maxilla with galea and lacinia distinctly separate but close together (Fig. 3). Palpiger distinct. Plectrum with 2 large setae; maxillary stridulatory teeth absent. Galea dorsally with a row of 3 large setae; ventrally with one long seta and 2 short setae. Lacinia dorsally with a row of 5 long setae near the mesal edge and one short seta posteriorly. Lacinia with an apical uncus.



Figs 2–4, 6, 7. *Platytomus tibialis* (Fabricius). 2 – last two segments of antenna, 3 – left maxilla, dorsal view, 4 – hypopharynx, dorsal view, 6 – thoracic spiracle, 7 – venter of last abdominal segment.

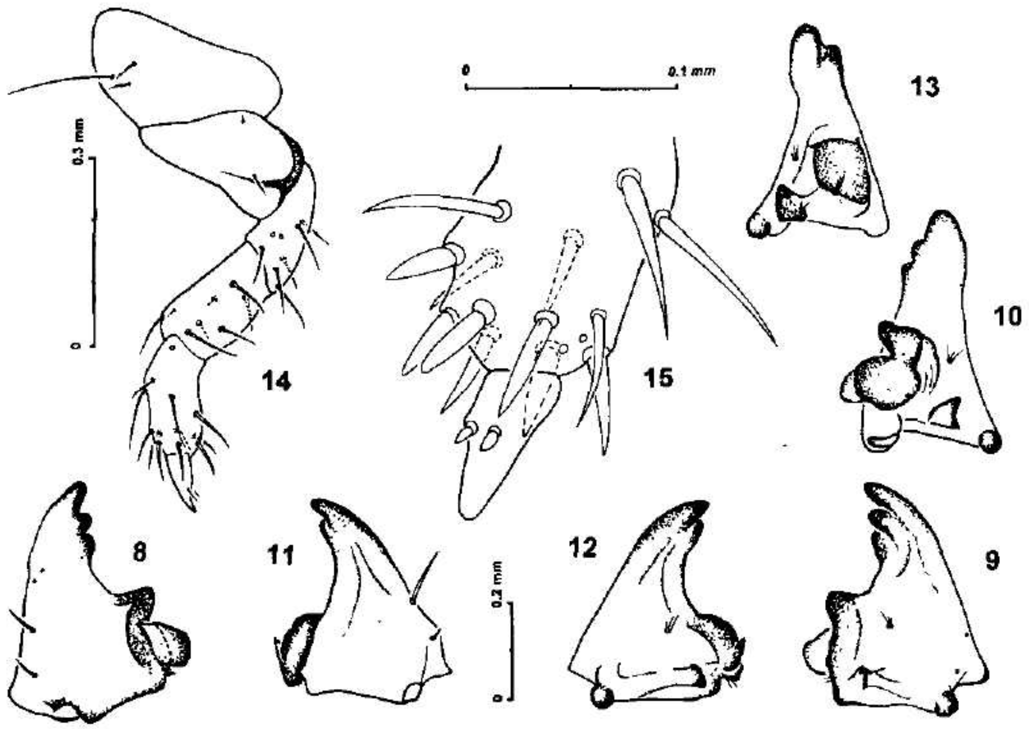
Hypopharynx with 3 setae on the exterior side of each labial palpus. Four macrosensilla and 2 setae on the central part of glossa. Glossa, anteriorly to the oncyli, with a transverse row of spinelike setae and 3 setae on each side (Fig. 4).

Epipharynx scarcely trilobed, pedium surrounded by phobae. Protophoba bistichous on the left and monostichous on the right; protophoba with 13–14 microsensillae. Crepide small, semicircular, with 2 microsensillae on it and 2 on either side of it. Dexiotorma produced cephalad and caudad; laeotorma smaller than dexiotorma (Fig. 5).

Legs four segmented, with well developed claws each with 2 short ventral setae (Figs 14–15).

Dorsal annulets of abdominal segments 15 with setation as follows: each prescutum with 4 short setae, each scutum with 3 long and 5 short setae on each side, and each scutellum with 7 short setae. Abdominal spiracle-bearing area each with 1 seta ventrally and 1 dorsal seta. Concavities of respiratory plates of thoracic spiracles facing posteriorly, those of abdominal segments facing ventrally (Fig. 6).

Raster with teges of 32–33 hamate setae scattered irregularly on the venter of the 10th abdominal segment, three or four long setae on either side (Fig. 7). Lower anal lobe divided into two sublobes placed adjacent to each other.



Figs 8–15. *Platytomus tibialis* (Fabricius). 8 – left mandible, dorsal view, 9 – left mandible, ventral view, 10 – left mandible, molar view, 11 – right mandible, dorsal view, 12 – right mandible, ventral view, 13 – right mandible, molar view, 14 – mesothoracic leg, side view, 15 – tip of mesothoracic leg.

DISCUSSION

Jerath (1960) and Richter (1966) gave a key to genera and tribes of Aphodiidae based on larval characters. Psammodiini differ from Aphodiini and some Eupariini (gen. *Saprosites* Redtenbacher, 1858) by the presence of two anal lobes, a galea with ventrally one long seta and a row of two or three short setae and the maxillary stridulatory area without teeth or a patch of very minute teeth. *Platytomus tibialis* presents these morphological characters.

The key established by Jerath (1960) to larvae of genera of the tribe Psammodiini can be completed as follows:

1 Galea ventrally with a long seta and a row of three short setae; each abdominal spiracle bearing area with 6–7 setae ventrally and 2 setae dorsally .... subtribe Psammodiina
– Galea ventrally with a long seta and two short setae; each abdominal spiraclebearing area with 12 setae ventrally and one seta dorsally. .... subtribe Rhyssemina 2
2 Each abdominal spiraclebearing area with 2 setae ventrally and one seta dorsally, each mandible dorsally with one or two setae .... *Pleurophorus* Mulsant 3
– Each abdominal spiraclebearing area with one seta ventrally and one seta dorsally; each mandible dorsally with two setae .... *Platytomus tibialis* (Fabricius, 1789)
3 Second and third antennal segments subequal, first long; laeotorma small as compared to dexiotorma in size; each mandible dorsally with a single seta .... *Pleurophorus caesus* (Creutzer, 1796)
– First and third antennal segments subequal, second short, laeotorma and dexiotorma more or less similar in size; each mandible dorsally with two setae .... *Pleurophorus longulus* Cartwright, 1948

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Patterns of chaetome modifications in ground-beetle larvae (Coleoptera: Carabidae)

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Abstract Important features of larval chaetome in Carabidae (Coleoptera), and principles of identification and homologisation of elements have been analyzed Satisfactory homologisation of certain chaetome structures is possible only when additional markers, i e sigillae are used in analysis Typology and topology of chaetome are described new designations for a number of structures are suggested Functional model of carabid larvae chaetome is discussed in its adaptive integrity based on correspondence of structure and functions of sensillae Main chaetome functions are described, i e covering, sensory, locomotory, and feeding-related, different types of their realization are considered Main ways of chaetome restructurisation are distinguished and described It is shown, that possibilities of chaetome modification in carabid larvae are restricted in general to three main types oligochaetosis, heteropolychaetosis, and homopolychaetosis, they are specific within taxa of tribe rank Chaetome modification type has to be taken into account in the studies of larvae taxonomy, and in elaboration of identification keys „Primary" set of sensillae as by Bousquet & Goulet (1984) is not plesiomorphic for carabids It is suggested that primitive state of chaetome is characterized by irregular distribution of sensillae, and by slight differentiation of general structures Key direction of chaetome evolution is optimization of sensory and covering functions, morphologically it is expressed in stabilization of chaetome and in formation of constant complexes of different sensillae Ways of chaetome modifications are specific for certain taxa, and their analysis can be used for elaboration of relationship scheme in carabids

Chaetotaxy, morphology, larva, Coleoptera, Carabidae

INTRODUCTION

Characters of chaetotaxy have been used in the systematics of ground-beetle larvae since the beginning of this century However, their applicability has been hampered by the lack of a convenient system of designations The attempts undertaken have mainly pursued but utility goals, that is, brevity of a description and/or compilation of keys to species of individual genera (e g , Emden 1935 for Cicindelinae alacosternale sensu Horn 1926, Nichols 1986 for *Antilliscaris* Banniger, 1937) carabid larval chaetome being highly diverse and variable, this has not allowed to apply those schemes for other genera It has long been quite clear, however, that a universal model of chaetotaxy can be developed concerning only a restricted set/number of setae Designating only the biggest cephalic setae, Habu & Sadanaga (1961) have pioneered this work This scheme has been applied to various ground-beetle groups (Habu 1973, 1981, Habu & Sadanaga 1961, 1965, 1970, Harris 1978, Zetto Brandmayr & Brandmayr 1978) A different practice of limiting the number of designated elements, which lies in using the chaetome of instar I, has been developed by Goulet (1983) In a modified way (Bousquet & Goulet 1984) that designation approach of the „primary setae and pores" has gained the general acceptance However, an over decade-long usage of that classification has revealed a number of defects which considerably restrict its applicability First of all, this concerns the ambiguous term „pore" (Makarov 1990, 1991, Maddison 1993) and highly formally criteria for delimiting „primary"

structures (Makarov 1991, 1993). This creates difficulties in designating the setae in larvae with strongly modified chaetome forcing some modern authors (e. g., Moore & Lawrence 1994) even to abandon approach of Bousquet & Goulet (1984) altogether.

According to Bousquet & Goulet (1984: 574) „setae and pores on the first instar larvae and their homologous structure on subsequent instars“ are just primary. Yet such a criterion of priority fails in very many cases.

First, among some ground-beetle larvae from the tribes Cicindelini, Elaphrini, Anthiini, Helluonini, etc., instar I displays more or less numerous accessory setae. Second, contrary trend is observed in a number of groups (Carabini – Makarov (1993), Bembidiini – Maddison (1993), Trechitae – Grebennikov (1995)), with instar I without some chaetome elements. A „primary“ set of pores is currently perceived as mainly plesiomorphic, though with neither proper embryological nor paleontological background, e. g., Arndt (1993). However, a study of well-preserved fossils (Makarov 1995) reveals that this requires confirmation.

It is thus reasonable to consider the scheme by Bousquet & Goulet (1984) as designating the most common set of cuticular sensory structures in carabid larvae. In this connection, below I shall avoid the notion „primary“, instead using „general“ as applied to the primary structures in the sense of Bousquet & Goulet (1984).

It is also noteworthy that technical difficulties in studying the carabid larval chaetotaxy force many authors to use traditional, largely macrostructural features as the leading diagnostic characters (Arndt 1993, Makarov 1994). Hence, chaetome characters serve rather for unravelling the relationships and for constructing phylogenetic trees or clades. In this way, chaetome structures require further investigations. Discarding phenetic schools, the basic characters underlying a phylogenetic reconstruction ought to meet a number of rather serious demands: (a) reliable homologization, (b) an exact revelation of the polarity/modality of a variation series, and (c) a low probability of a character's reversed condition (Ax 1987, Pesenko 1993). Though a phylogenetic importance of larval features has been repeatedly discussed (Goulet 1978, Arndt 1989, 1993, Makarov 1990), to the best of knowledge, no special evaluation of chaetome characters has hitherto been performed.

MATERIAL AND METHODS

Material serving the basis for this work is housed in the collection of Zoology and Ecology Department of the Moscow Teachers' Training University. This material comprises 453 species from 84 genera and 39 tribes, mostly fixed in 70% ethanol. Besides, larvae of beetles from other families have been studied (Dytiscidae – 4 species, Hydrophilidae – 4, Staphylinidae – 5, Histeridae – 2, Drylidae – 1, Cantharidae – 2, Elateridae – 3, Tenebrionidae – 2) as well as larvae of allied Neuroptera (Osmylidae, Ascalaphidae and Myrmeleonidae – one species from each), for detailed list of material examined see Appendix. A proportion of samples is mounted either as constant micropreparations with the Faure-Berlese medium or as temporary micropreparations with glycerol, according to the conventional techniques. Altogether, 1780 specimens have been treated. Larvae were examined under MBS–1, MBI–2 and P–16 stereomicroscopes at magnitudes ranging from 6× to 900×.

Some fine structures of larvae were studied with a Cambridge Stereo-Scan 250MX and Hitachi S-450 scanning electron microscopes.

Statistics was performed for revealing the variation range of setal size groups. For this purpose, 8 model species (*Nebria kirgisica*, *Diacheila fausti*, *Blethisa multipunctata*, *Elaphrus lapponicus*, *Clivina fossor*, *Asaphidion flavipes*, *Agonum muelleri*, *Harpalus rufipes*, *Panagaeus cruxmajor*, *Cymindis lateralis*) were chosen for measuring the length of the setae on the frontal and parietal sclerites, on the pronotum, on abdominal tergite and sternite IV and on the urogomphi. From 6 to 25 setae have been measured on each of the sclerites, with their relative lengths considered as percentage of the longest (100%). Grouping was undertaken using K-means clustering with the program STATISTICA 4.3.

Suprageneric taxa accepted here are mainly according to the system proposed by Kryzhanovskij (1983) and Kryzhanovskij et al. (1995). Notation of setae and pores follows that of Bousquet & Goulet (1984).

Tab. 1. Representation of „general" set setae and density of sensillae on body surface of some Carabidae larvae. (R – level of chaetome reduction, portion of seta in % from „general" set; N – average number of all sensillae on 1 cm^2 of sclerit surface.)

Species	Sclerit							
	Frontale		Parietale		Sternum		Tergum	
	R	N	R	N	R	N	R	N
Calosoma auropunctatum	100	11.8	88	16.3	100	13.3	66	22.2
Carabus glabratus	94	23.7	70	22.2	100	11.8	60	32.6
C. convallium	82	22.2	65	20.7	100	13.3		26.6
C. janthinus	70	14.8	62	14.7	100	39.9	47	15.2
C. cumanus	82	20.7	70	23.7	83	8.9	60	23.7
C. circassicus	82	11.8	56	19.2	83	7.4	40	17.8
C. pratensus	76	9.2	53	12.5	83	3.9	40	4.4
Cychrus caraboides	58	14.4	64	24.4	100	7.5	26	19.4

RESULTS

Phylogenetic evaluation of chaetome features

A study of the topography of larval sensillae in various beetle families (Hydrophilidae, Staphylinidae, Dytiscidae) shows that numerous, particularly soil-dwelling forms display a chaetotaxy often thoroughly similar to that typically occurring in ground-beetles. And several complexes of sensillae (e. g., $PA_{1,2,3,a}$; $PA_{6,17,m,n}$; $FR_{1,a}$) are traceable even among such taxa phylogene-tically remote from ground-beetles as Tenebrionidae. For example, when comparing with the generalized carabid type, 16 out of 19 setae and 7 out of 15 „pores" are reliably identifiable in the larvae of *Helophorus* (Hydrophilidae) (Fig. 2). A similar pattern is observed also among certain larvae of Staphylinidae (Figs 3, 4) and even in Elateridae (Fig. 12). The chaetome of tergites and sternites is often even more alike (Figs 5–11). For comparative purposes, it suffices to recall that, among the Carabini larvae, there are only 15 setae and 10 „pores" on the parietal sclerites. Amongst lesser larvae of the supertribe Trechitae, a considerably reduced set of pores is marked (Grebennikov 1995), and soon.

Hence, as regard a similarity of larval chaetomes of various beetle families, only two hypotheses seem admissible: either the tipization is possible only at the order level (this being a fundamental feature of all beetle larvae), or the chaetome's adaptive modifications exceed significantly the extent of inadaptive restructurings within the family.

The larval chaetome of ground-beetles poorly resembling that of aquatic Adephaga (Dytiscidae, Gyrinidae), this is rather evidence favoring the second alternative. Thus, the resemblance between the generalized chaetome larval types of carabid and the typical diving beetle genus *Ilybius* (Adephaga: Dytiscidae) is significantly less than, for example, with the near-water genus *Helophorus* (Polyphaga: Hydrophilidae) (Figs 1, 2, 5, 6, 8, 11). More often these are sensillae which location is restricted to the sigilla both of the larger muscles (abductors and adductors of the mandibles, etc.) and endoskeleton.

Consequently one may speculate that, the structure of a chaetome is significantly determined by the way of larval life. The structural particularities are displayed only at the level of most strongly interrelated complexes of sensillae and sigilla. Thus, a generalized chaetome in the sense Bousquet & Goulet (1984) cannot be regarded ancestral to ground-beetles.

One more problem of a phylogenetic interpretation of chaetome characters is related to the difficulties in evaluating the plesiomorphies. The fact that a number of „primary" sensillae are

lacking while „secondary" setae are present in instar I larvae of certain tribes (Carabini, Cychrini, Brachinini, Dyschiriini, etc.) means that a generalized chaetome in the initial sense (Bousquet & Goulet 1984) is treated perhaps too formally and includes also „secondary" structures. Besides that, in the cases when some chaetome elements are missing, it appears impossible to attribute that to convergences (homoplasy) or to symplesiomorphies, and this can result in wrong kinship evaluations. In addition, a possible instauration has been demonstrated for a number of insect structures, that is, repeated origins of a phenotypically lost feature due to conservation of genetic copies; setae thereby appear particularly strongly inclined to that process (Emelyanov 1987).

All this evidently questions the utility of the chaetome for studies on carabid phylogeny. In my opinion, the only way out lies in modifying the methodology of evolutionary reconstruction of larvale.

To a considerable extent, imaginal evolution is related to the development of reproductive isolation mechanisms, often without expressed adaptive roles. In contrast, the evolution of preimaginal stages is mainly adaptive. A natural way of reconstructing their phylogeny would lie in an analysis of their adaptive systems and functions.

As applied to arthropods, an evolutionary method of phylogenetic reconstructions based on an interpretation of adaptive traits of functional systems has been developed by Manton (1959, 1977). As regards ground-beetles, these problems have been analyzed mainly by Evans (Evans 1980, 1982, 1986, Evans & Forsythe 1984), the locomotor system of the imago taken as an example. It has been noted therewith that adaptive systems display polarity more readily and are not subjected to reversions (the law of progressive specialization). No study of larvae in this aspect has hitherto been conducted.

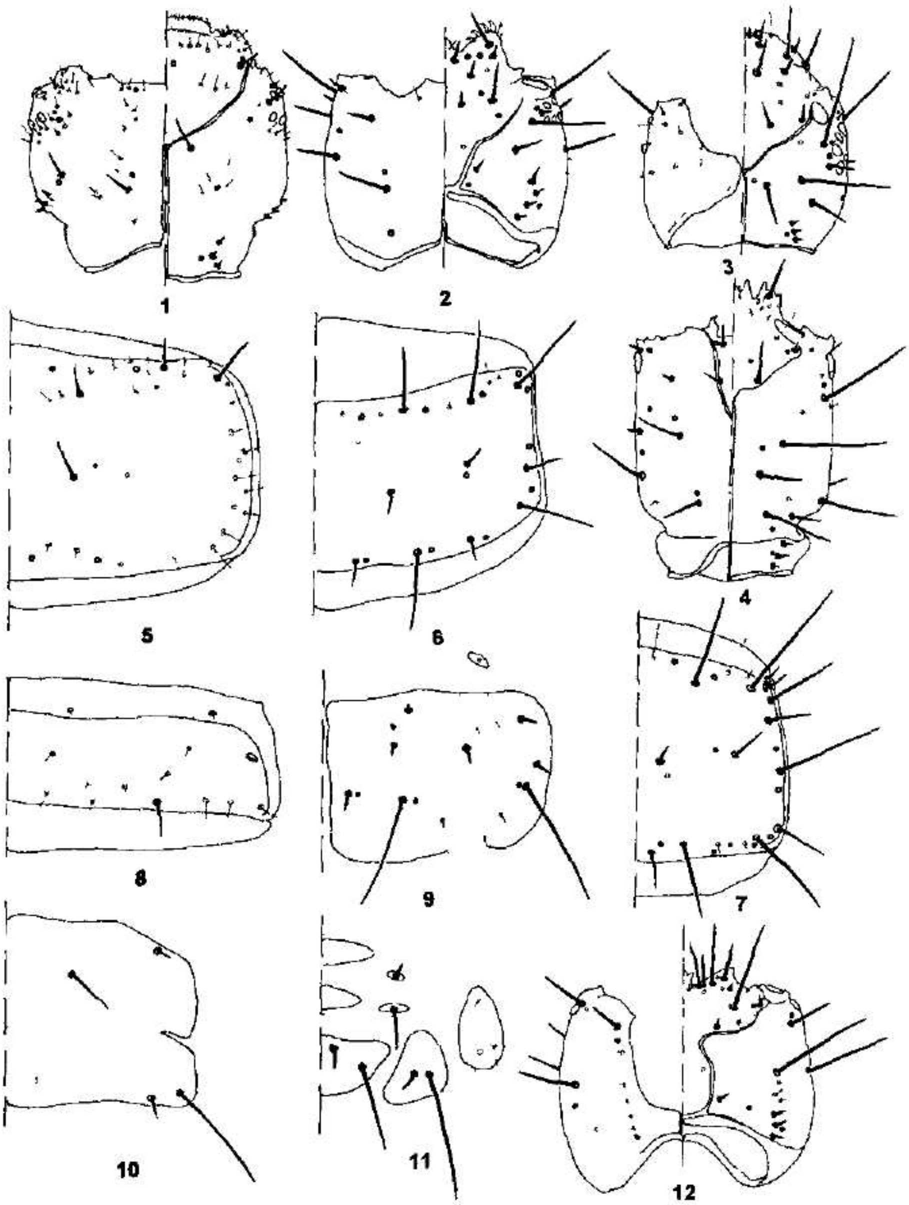
Hence, the objective of the present work can be defined both as a morphofunctional description of the chaetome and an analysis of its modifications.

Chaetome as a whole

The chaetome in a strict sense is understood here as all cuticular structures associated with primary external receptors, i.e. sensillae. Hence, the main function of a chaetome is sensory. In a broad sense, the chaetome also encompasses microtrichia (Fig. 44a) and spines (Fig. 29), i. e. a number of cuticular derivatives closely interacting with sensory elements. Multifunctionality of many sensillae and their interactions with non-sensory structures extend significantly the set of the functions carried out by a chaetome (see below).

In general, a ground-beetle larval chaetome can be characterized by the following particulars: (a) great diversity of sensillae, with numeral dominance of trichoid and basiconical mechanoreceptors; (b) low number of sensillae-distant receptors; (c) infrequent occurrence of complex setae of complex form; (d) absence of compound sensory organs (chordotonal and others al.), their functions taken up by individual sensillae.

From a standpoint of adaptive value, adaptive and largely inadaptive structures can be distinguished in a chaetome (Makarov 1990, 1991). A chaetome's functional integrity is evident, for such alterations as an increased number of setae, changes in their mean length, the formation of drusy setae, etc., take place coordinately in various sclerites. Often they are accompanied also by modifications of the sculpture, while changes in inadaptive structures are less evident. However, an analysis of the kno wn patterns of reduction (Makarov 1991, 1993, Grebennikov 1995) shows that sensillae get lost in a regular way. Thus, Carabini display a reduced discal complex, where as among Trechitae the reductions concern the posterolateral groups of sensillae of the thoracic and abdominal tergites.



Figs 1–12 Chaetotaxy of the separate body parts of Coleoptera larvae in different families (schematic) 1–4, 12 – cephalic capsule (left – ventral view, right – dorsal view), 5–7 – right half of pronotum, dorsally, 8, 9 – abdominal tergit IV, dorsally, 10 11 – abdominal ventrites IV, ventrally 1, 5, 8, 10 – *Ilybius fuliginosus* (Fabricius), L3 (Dytiscidae), 2, 6, 9, 11 – *Helophorus aquaticus* (L), L3 (Hydrophilidae), 3 – *Tachinus* sp , L3 (Staphylinidae), 4, 7 – *Philonthus* sp , L3 (Staphylinidae), 12 – *Athous* sp , L2 (Elateridae) Sensillae, corresponding to generalized type are shown as solid, other sensillae as dotted

Hence, the larval chaetome of Carabidae can be considered as an integral system exhibiting its own patterns of change.

Below, the basics are briefly presented of a formal classification of chaetome elements.

The principles of identification and homologization of chaetome elements

In the framework of cladistics (Ax 1987) and considering the newest requirements of the hypothetic-deductive methodology (Pesenko 1993), the first condition of adequacy of a cladistic reconstruction is character analysis aimed at a revelation of homoplasies and of initial and derived states.

The specificity of larval stages (scarcity of fossil evidence, poorly developed biochemical and genetic approaches) greatly restrict the set of the methods admitted to establish the homologies. In fact only three Remane's criteria remain (Remane 1956, with consideration of additions by Pesenko 1993): resemblance of position, resemblance of special quality, and transitions through intermediate forms. Applicability of the latter criterion thereby faces additional difficulties, because even in well-studied carabid groups, larvae are known for less than 30% species.

At the same time, owing to both a well-expressed embryonization and a number of structures getting considerably modified in the course of carabid larval development, ontogenetic criteria appear partly useful as well in unravelling homologies by origin and polarities by antecedence.

Homologization of chaetome elements in ground-beetles is generally based on the fact of retention of sensillae innervation along with growth and development (Wigglesworth 1953). The known patterns of aberrations conserved for stage to stage (for example, duplicated setae PR_8 in *Carabus granulatus*) can be evidence of ontogenetic succession of chaetome elements as well.

Below, the main aspects of classification of chaetome elements and the methods of homologization are briefly considered.

Typology

The generally accepted classification of Bousquet & Goulet (1984) discriminated two classes of sensillae: setae and pores. Yet whereas a seta largely implied a trichoid-type sensilla, pores were understood as embracing all structures with a small agile portion: conical, campaniform, and placoid sensillae. A number of basiconical sensillae (PR_7, ME_{10}, TE_8) were therewith designated as setae, while a bit lesser sensillae (FR_f) as pores.

The typological classification of sensory structures of ground-beetles presented here roots in classics of insect morphology (Snodgrass 1935, Slifer 1970, McIver 1975, etc.), external receptory structures encountered in carabid larvae can be divided into functional groups with distinct morphological characters.

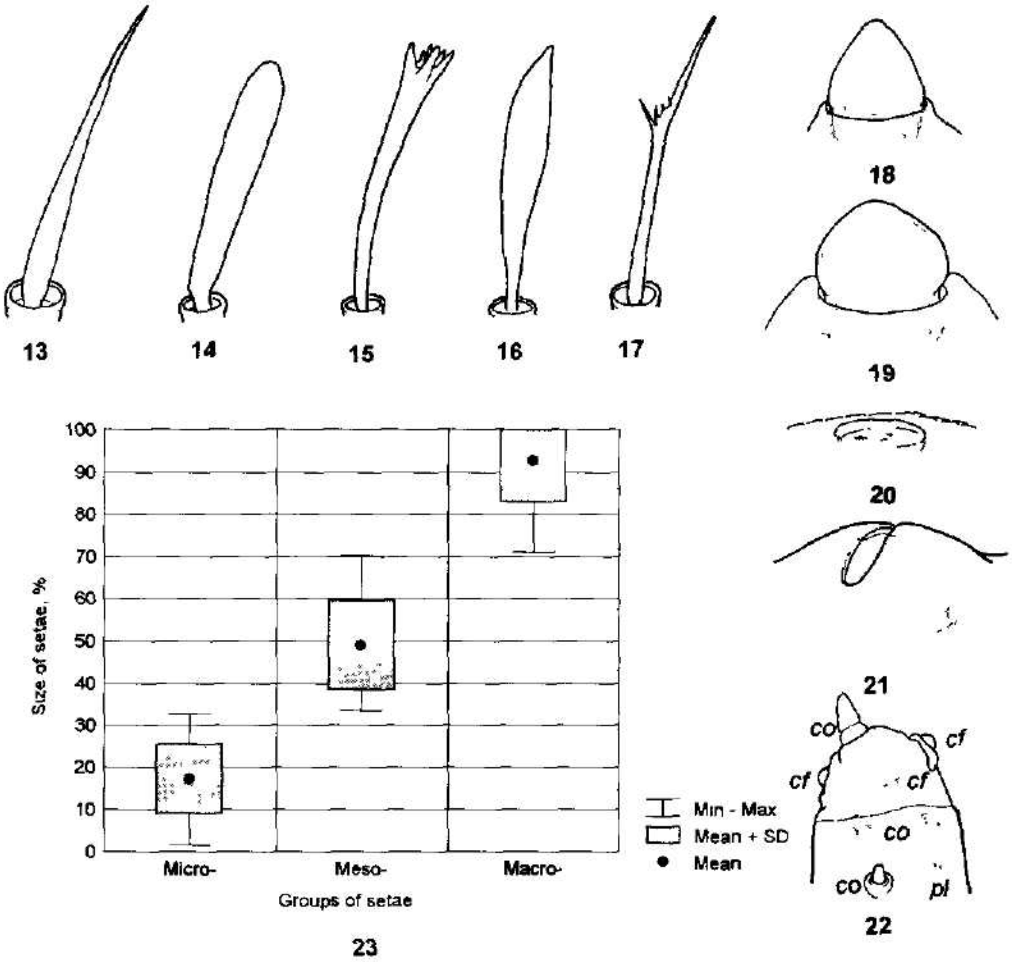
MECHANORECEPTORS. Formed on the basis of a bipolar neuron, associated with cuticular structures of three types:

(a) Trichoid sensillae or setae (hair sensilla, seta, sensilla chaetica, sensilla trichoidea), the biggest and the most thick-walled, often with an apical pore, they can also perform the function of a contact chemoreceptor (McIver 1975, Spence & Sutcliffe 1982). Receptory fields perceiving joints' articulation and typical in the imago are unknown in larvae. The only possible exception is gPS. These fields' function is carried out by individual sensillae located so that their contact to the environment is limited. Such are PY_1, TE_3, CO_{1-3}, CO_{14-17}, possible PA_{1-3}, Other proprioreceptors are represented by campaniform sensillae (see below).

Accessory setae differ in shape: needlike, drusy, baccilliform and phylloid, boughform, spines etc. (Figs. 13–17).

Usually, larval setae differ in size quite considerably. A statistical analysis carried out has revealed that among them three groups can be reliably distinguished. I designate these groups as micro-, meso-, and marcosetae, respectively. The border between first two groups setae approach each other and, no differentiation into micro- or mesosetae being possible in some particular cases (Fig. 22).

The size restricts the morphological diversity of setae. Thus, only microsetae appear to display a bacilliform or phylloid appearance. In contrast, only meso- or macrosetae can be bacilliform or drusy.



Figs 13–23. Types of sensillae in carabid larvae. 13–17 – trichoid sensillae of different shape (13 – needleform (typical) seta, 14 – bacilliform, 15 – druseform, 16 – phylloid, 17 – boughform), 18 – conical sensilla, 19 – campaniform sensilla, 20 – placoid sensilla, 21 – „lyriform organs" (deepped campaniform sensilla). Fig. 22. Scatter-diagram of the lengths of three dimensional setae group (explanation in text). Fig. 23. Unit of different sensillae on the top of last joint of labial palp in *Agonum muelleri* (Herbst), L3. Abbreviations: co – conical sensille, cf – campaniform sensille, pl – placoid sensille.

(b) Campaniform sensillae (Fig 19), described already by Berlese (1910), are homologs of setae (Snodgrass 1935, Schmidt 1973) Their function is proprioreceptory Both special sensillae $TR_{a,f}$ (Fig 21) and „lyriform organs“ on legs and tergites are referred here Campaniform sensillae are widespread8 in beetle larvae (Zacharuk 1962), often being associated in functional units (McIver 1975)
(c) Digitiform sensillae are specialized derivatives of setae on mouthpart appendages Despite an apical pore, they are only mechanoreceptory (Zacharuk et al 1977) Apparently, they serve for orientation in soil tunnels, percepting the vibration of walls emitted by the victim (op cit) Similar structures are known in the imago as well, although their function is olfactory (Honomilch 1980)

CHEMORECEPTORS Chemoreceptors are less diverse in ground-beetle larvae Morphologically, most can be attributed to a group of contact sensillae (Slifer 1970, Tyshchenko 1986) represented by microsetae, conical and, less frequently, placoid sensillae

Microsetae are located at the apices of the antennae and urogomphi as well as on sides of tergites Basi- and coeloconical sensillae (Fig 18) are usually placed on the head capsule and both on thoracic and abdominal sclerites They form most of „secondary pores“ Placoid sensillae (Fig 20) seem to be the most highly specialized chemoreceptors (e g , $AN_{a,d}$) Maddison (1993) believes that they represent chordotonal organs

The large basiconical sensilla on antennomere 3, known as „sensorium“, is also referred to the group of chemoreceptors Apparently, it performs a hygroreceptory function

Regularly, chemo- and mechanoreceptors jointly form the functional groups For example, frequently there is a medial chemoreceptor surrounded by campaniform mechanoreceptors at the apices of the antennae, maxillary and labial palps (Fig 23)

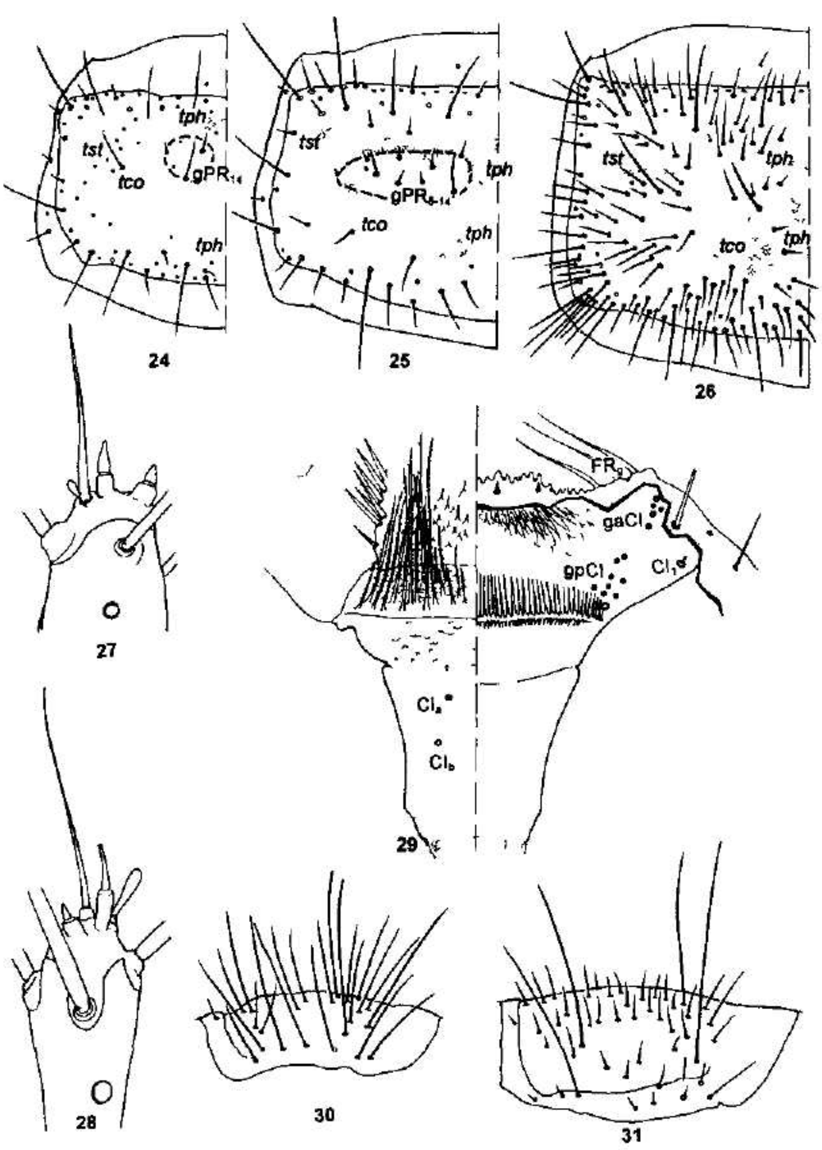
Intermediate sensillae forms are possible only amongst poorlv specialized sensillae of trichoid or conical type

Topology

The system of chaetome designations as developed by Bousquet & Goulet (1984) is based only upon the elements' dispositions In so doing at least for two reasons, there are difficulties in an exact designation of sensillae (a) a strong structural reorganization of larva body when the habitual system of topographic correlations is lost (e g , Cicindelini), (b) substitution of one sensilla type by other one and (c) absence of individual chaetome elements (e g reduced tergal setae in Carabini), also deteriorating the system of designations Subsequently, due to adoption of designations for some „secondary“ setae (like AN_{α}, the latter have been tended to be treated as homologous elements along with „primary“ setae (Arndt 1993) Recently, based on a statistic analysis of morphometric characters (Brinev 1995), the extent of correlation among setae has been shown to be independent from the distance between ones Hence, identification of the setae based solely on their interpositions is insecure

To overcome these difficulties, additional markers have been used for the determination of chaetome elements The method of sigillotaxy (Makarov 1989, 1991, 1993) is based on the utilization of sigilla as markers for the sites of muscle attachment to the endoskeleton, all well distinguishable by a well-developed primary microsculpture Another technique lies in using for diagnostic the rather stable functional complexes (usually, this is a trichoid sensilla in combination with a campaniform one) In both cases, a secure identification (and thus homologization) becomes possible of almost of structures of a chaetome

As regards the larvae with a complex chaetome (e g , Elaphrini, Callistini, Galeritini, Anthiini, numerous Harpalini and Lebiini, etc), the problem of an exact homologization cannot be



Figs 24–31 Some details of chaetotaxy in carabid larvae 24–26 – designations of pronotum seta groups show by the example of larvae in Elaphrini tribe (right half of pronotum, dorsally, muscles sigilles are dotted), 27–28 – structure variations of terminal sensory complex of fourth antenna joint, dorsal aspect, 29 – sensillae of cibarium, from the left – hypopharynx, from the right – epipharynx (explanation in text), 30, 31 – chaetome of abdominal tergit IV, lateral aspect (30 – homopolychaetosis, 31 heteropolychaetosis) 24 – *Elaphrus riparius* (L), L3, 25 – *E cupreus* Duftschmid, L3, 26 – *Blethisa multipunctata*(L), L2, 27 – *Pterostichus strenuus* (Panzer), L1, 28 – *Epaphius secalis*(Paykull), L3, 29 – *Agonum exaratum*(Mannerheim), L3, 30 – *Amara brunnea* (Gyllenhal), L3, 31 – *Cymindis vaporariorum* (L), L3 Abbreviations tph – tergo-phragmal, tst – tergo-sternal, tco – tergo-coxal muscle complexes Designation of setae according to Bousquet & Goulet 1984, muscle groups according to Kiler 1964, with modifications

solved at the level of individual elements. The notion of a group of sensillae has been introduced for such cases (Makarov 1993), meaning a unit of the chaetome structures delimited by demarcation zones (usually, by sigillae). In the norm, the groups are designated by the „primary" seta, e. g. gPR_8 in *Elaphrus* (Fig. 24). More seldom, a group encompasses several setae ($gPR_{8\ 14}$ – Fig. 25). Finally, in extreme cases of chaetome complication, one must speak only about the complexes of sensillae: anterolateral, anterodiscal, etc. (Fig. 26). Since it is sensillae innervation that is at the base of their homology, we consider the homology of an individual seta and a respective group as possible.

It is noteworthy that some sensillae retaining relative stability in structure and position remain undesigned (Maddison 1993). This mainly concerns complexes of sensillae of antennomeres 3 and 4 as well as of the buccal cavity.

The complex of sensillae of antennomere 3 comprises a big campaniform sensorium and a group of 1–3 sensillae placed more dorsally. The group usually encompasses two conical and/or bacilliform as well as one spherical or placoid sensilla. Modifications of this complex (besides the above variations in the sensorium) are reduced to a dwindling number of sensillae up to their complete decline.

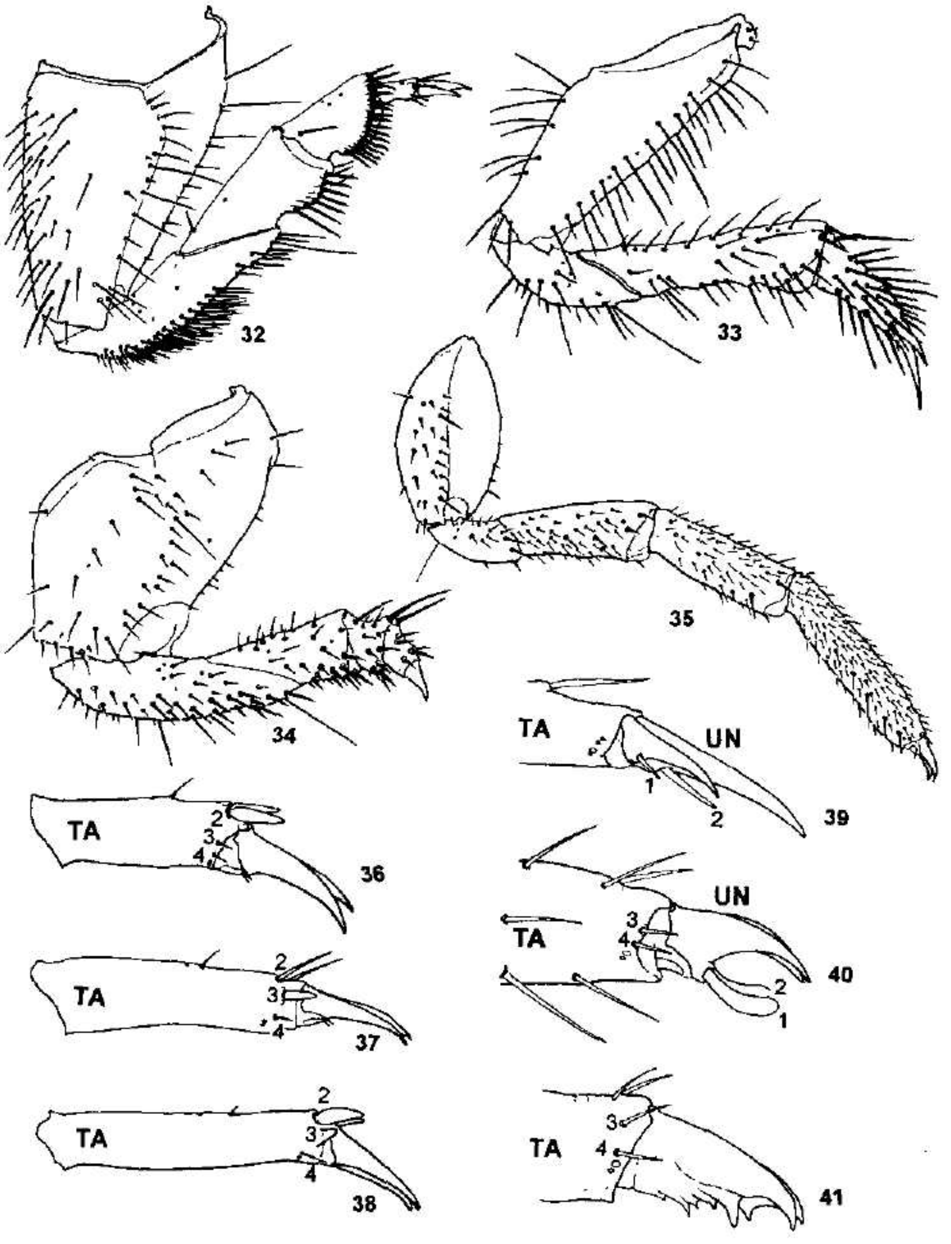
In a typical case, the terminal complex on the antenna includes one apical seta AN_6, two dorsal conical and one ventral bacilliform sensilla. This set is relatively stable within the family. The modifications known to us lie in the bacilliform sensilla being substituted by campaniform ones, one of the conical sensillae reduced, and the length ratios changed in the chitinous derivatives of the tormogenous and trichogenous cells (Figs 27, 28).

The absence of additional markers in the apical part of antennomeres 3 and 4 makes it impossible to homologize the sensillae in case of any reduced or considerably modified elements. Hence, in contrast to the opinion of Maddison (1993) it appears hopeless to introduce designations for such structures. In their descriptions, it is advisable to use such toponymic notions as, e. g., a „medial conical sensilla".

Finally, the buccal cavity supports its own complex of sensillae. Their main part (a group of conical and campaniform sensillae) are placed on the epipharynx, only two pairs of campaniform sensillae being located on the cibarium. The latter sensillae are highly stable throughout the family, while the epipharyngeal ones are highly variable. Among them, more or less constantly distinguishable is only a short lateral seta. In general, the remaining group forms a more or less distinct row of $FR_{8,9}$ setae to the fore angles of the cibarium, which is sometimes clearly divided by a medial impression of the epipharynx into an anterior and a posterior groups. Relative constancy of some mouthpart sensilae enables to give designations for them (Fig. 29). Analogously to Bousquet & Goulet (1984) lateral seta is called CI_l (from cibarium), sensillae of cibarium itself are CI_a and CI_b, while epipharynx group of sensillae is gCI (and could be divided into subgroups gaCI and gpCI).

One more sensillae, that has not yet been defined (Maddison 1993), lays on the front edge of paraclypeus in the area of $FR_{8\ 9}$ seta. It is rather constant, and in some cases could be considered as marker sensillae, dividing the groups of seta FR_8 from FR_9 (Fig. 29). It is suggested to define this sensillae as FR_g.

Topology of specialized sensillae (mostly distant chemo- and hygroreceptors) is more constant that the topology of little specialized trichoid and conical sensillae. Chaetome modification happens mainly due to contact chemo- and mechanoreceptors, which include typical seta and different conical and campaniform sensillae.



Figs 32–41. Structure and chaetotaxy of carabid larvae legs: 32–35 – middle leg, frontal view (32–34 – excavatory legs, 35 - running legs); 36–38 – tarsus of middle leg, frontal view; 39–41 – apex of tarsus, frontal view. 32 – *Scarites bucida* Pallas, L3, 33 – *Cicindela hybrida* L., L2, 34 – *Orthogonius ?acutangulus* Chaudoir, L3, 35 – *Callistus lunatus* (F.), L3, 36 – *Molops piceus*(Panzer), L1, 37 – *Tricholicinus setosus* J. Sahlberg, L3, 38 – *Masoreus wetterhali* (Gyllenhal), L3, 39 – *Loricera pilicornis* (F.), L2, 40 – *Drypta dentata*(Rossi), L3, 41 – *Paradromius linearis* (Olivier), L3. (35 after Makarova & Makarov (1996), other – orig.). Notation of „primary" setae and pores follows that of Bousquet & Goulet (1984).

Functional model of chaetome

Functions of certain chaetome elements of carabid larvae are almost unknown, and special physiological experiments are needed to study them. However, more or less precises relationship between structure and function has been revealed for the majority of cuticle sensory structures of insects (Snodgrass 1935, Dethier 1963, Tystchenko 1986). Therefore already now it is possible to describe the general model of carabid larvae chaetome.

This model is based on the following statements:

- all cuticle structures including the number of derivative seta are sensory
- most thichoid sensillae judging by SEM data do not have apical pore, and thus are considered as mechanoreceptors
- distant receptors are lacking in typical cases

Chaetome as well as other derivatives of cuticle contributes to four functions, discussed below in order of their importance.

Covering structures

In this group we include trichoid sensillae of different size and microtrichia. Their presence in large numbers ensures isolation of larvae body from the environment, that is realized in three ways:

a) The most hygrophilous forms which live in permanent contact with water (Callistini, Elaphrini) are characterized by noticeably different in size „general" seta, numerous additional seta, and by development of isolating chaetome on the appendages (Callistini: *Callistus*).

b) In xerophylic and psammophylic larvae (Anthiini, part of Zabrini and Harpalini) macrosetae prevail in secondary chaetome; sometimes their size is comparable to „general" seta.

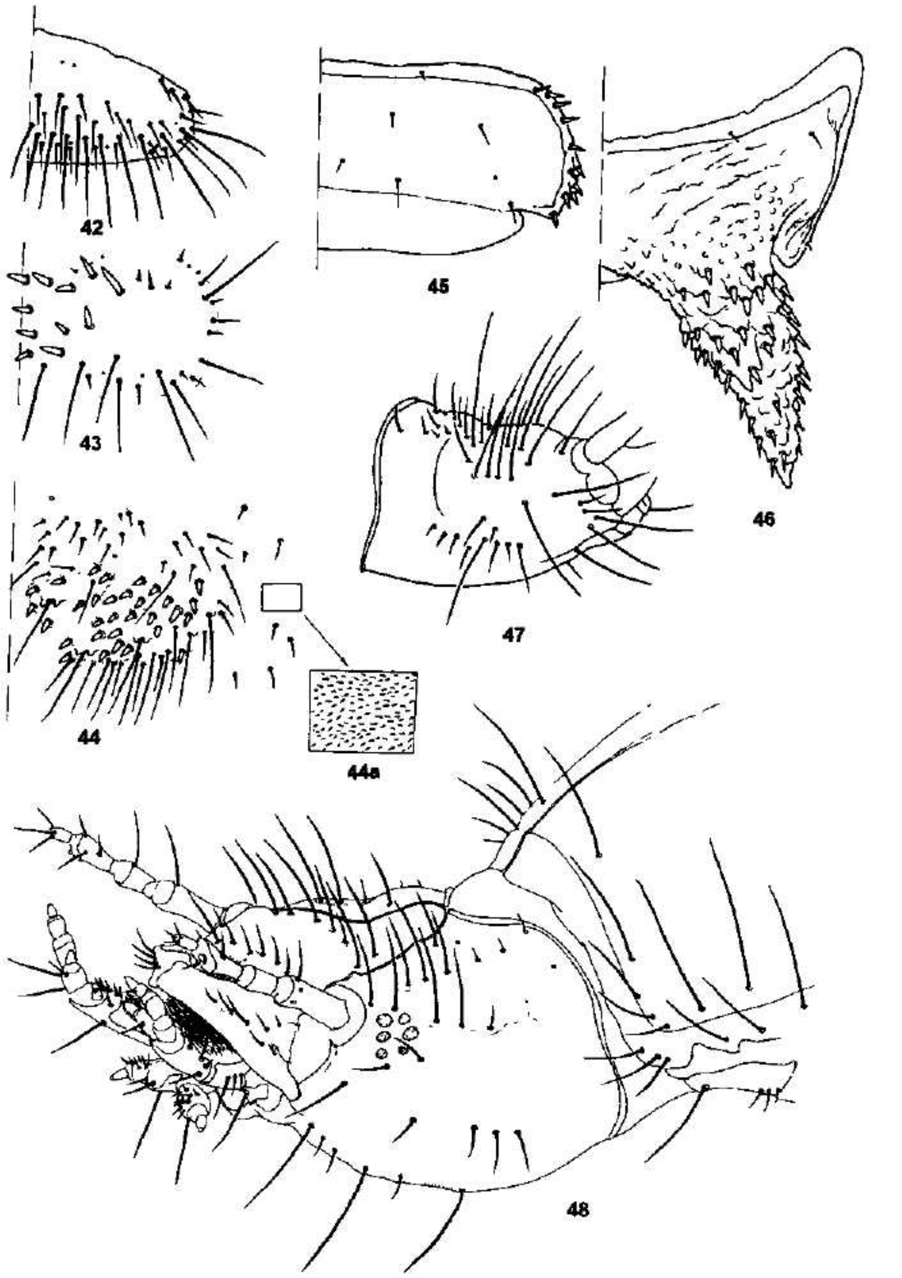
c) In *Orthogonius* and *Cychrus* larvae very peculiar thin and dense protrusions are formed on sclerites on intersclerite membranes; the latter are microtrichia but not sensillae.

Locomotory and bulldozer structures

As locomotory we consider the structures of chaetome, which are helpful for larvae movements over or in the substrate. They are localized on appendages, and in excavating forms also on urogomhi and rarely on abdominal tergits. Excavatory structures which enable to move apart dense portions of substrate are treated as separate variant (Lyubarskiy 1992); they are located mainly on the head and anterior margin of pronotum.

Movements on solid dense substrates leads to elongation of distal parts of appendages and to development of more or less parallel rows of spines ($gTA_{5,6}$, $gFE_{3,4}$) mostly on the ventral side (Fig. 35). In specialized forms claws and $UN_{1,2}$ setae on pretarsus are modified as well (Figs 39–41).

On the contrary, in excavatory forms one can observe shortened distal parts of appendages (Figs 32–34), as well as formation of apical crowns of spines (gTA_{2-7}, gFE_{2-5}). Quite often non-allied forms have similar structure of appendages (for example *Omophron*, *Cicindela*, *Scarites*, *Orthogonius*). Unlike the surface-dwelling larvae, adaptations in excavatory ones cover a number of structures. Thus, besides appendages, urogophae and abdominal tergits are adaptively modified as well (Figs 45, 46). Chaetome modifications are similar in all cases. Development of supporting structures such as spines and/or seta (Figs 42–44) on medium abdominal tergits (II–VI in *Omophron*, *Daptus* and *Orthogonius*; IV–V in *Brullea* (Harris 1978)) could be considered the most interesting. It is possible that specific structure of fifth abdominal segment in Cicindelini larvae represents the extreme variant of such specialization.



Figs 42–48 Supporting and bulldozer structures on dorsal surface in carabid larvae. 42–45 – abdominal tergit IV, right half, dorsally (44a – magnified part of Fig 44), 46 – right half of abdominal tergit IX and right urogompha, dorsally, 47 – cephalic capsule, right aspect, 48 – head and anterior margin of prothorax, anterolateral aspect 42 – *Omophron limbatum* (F.), L2, 43 – *Daptus vittatus* Fischer von Waldheim, L3, 44 – *Orthogonius ?acutangulus* Chaudoir, L3, 45,46 – *Callisthenes semenovi* Motschulsky, L3, 47 – *Brullea antarctica* (F.), L3, 48 – *Zabrus spinipes* (F.), L2. (47 after Harris (1978), other – orig.).

Within one type of locomotory chaetome adaptations free combinations of different element functions can take place. Thus, in majority of ground-beetle larvae setae $TA_{2,7}$ on the end of leg are modified into spines, while seta $TA_{3,6}$ fulfil sensory function (Fig. 36). In *Tricholicinus* and *Masoreus* on the contrary $TA_{2,7}$ fulfil sensory function, while $TA_{3,6}$ is used in locomotion (Figs 37, 38). Similar alteration of functions is observed in appendages chaetome of *Thalassophilus* (Grebennikov 1996) and *Orthogonius* (Fig. 34).

It is necessary to mention, that the number of claws, although seeming to be adaptive feature, is not directly related with locomotion type.

Bulldozer structures are usually represented by rows of strong seta and spicules on the head, mandibles, and rarely on other appendages (Figs 47, 48). Sometimes modifications are found also in upper prothorax (for example thickened seta in front corners of prothorax found in *Epaphius*).

Specialized sensory structures

This group includes only sensillae, specialized for analysis of certain signals. They are localized mostly on head, appendages, at the edges of tergits, and are represented by enlarged trichoid macrosetae (mechanoreceptors), as well as by basiconical, conical and placoid sensillae which act as chemoreceptors.

Comparison of chaetome in representatives of different tribes together with analysis of its' ontogenetic changes enables to outline the following main trends in development of sensory complex of carabid larvae:

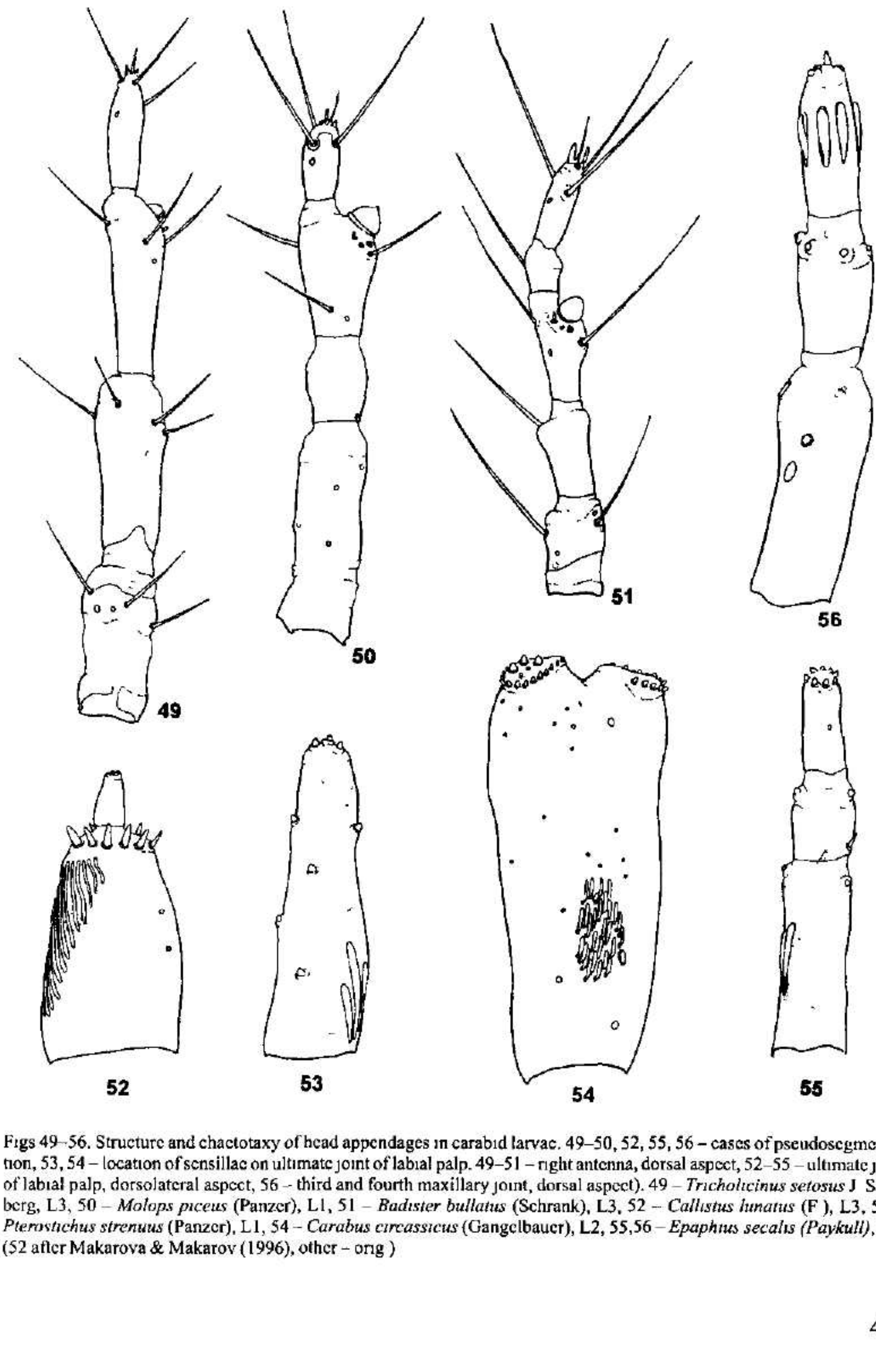
a) Increase in active zone of sensillae. Usually this is reached through prolongation of periphery trichoid sensillae mainly on head appendages and on urogomhi (for example in *Notiophilus*, *Leistus*, *Nebria*, *Loricera*, *Galerita*). In open-living forms with short seta (some Callistini and Carabini) compensatory elongation of seta-bearing appendages is observed.

b) Concentration of different sensillae into sensory fields, that sometimes coincide with increase in their size and number. The latter is most well expressed for groups of basiconical sensillae, located at apical segments of labiale and maxillary palps. In the most simple case two or three basiconical sensillae form diffused lateral group at the base of segment, other sensillae (conical and placoid) are located distally (Fig. 53). Complexity increases to to enlarged number and/or size of basiconica l sensillae; they form more or less compact group which position shifts to distal (Fig. 54). Other types of sensillae are also included in this group. Such structure is characteristic mostly for open-living predatory larvae. Apical sensillae complexes on labiale and maxillary palps develop similarly.

On the periphery of tergites trends of sensillae concentration are less pronounced. The best example is found in Licinini tribe: dense concentrations of sensillae are formed on epypleurits, and seta EP_1 and HY are noticeably prolonged.

Specific variant of increased complexity in antennae chaetome is found in Scaritini larvae, and also in some Harpalini and Pterostichini. In these cases different modifications of sensorium at the third antennae segment takes place, such as flattening, increase in size, or formation of a group of flat sensillae at the place of sensorium. These changes are characteristic mostly to the forms with slightly sclerotised covering which inhabit arid landscapes. It can be thus suggested that this trend is r elated to the need of precise orientation after humidity gradient.

c) Mobilization of sensory complexes. It is expressed in development of pseudosegment on head appendages. Four different variants of this trend have been found in carabid larvae: 1) separation of sensillae group in the apical part of labiale palp (Callistini – Fig. 52); 2) separation of antennal circle and formation of additional segment at the base of antennae (Pterostichini: *Mol-*



Figs 49–56. Structure and chaetotaxy of head appendages in carabid larvae. 49–50, 52, 55, 56 – cases of pseudosegmentation, 53, 54 – location of sensillae on ultimate joint of labial palp. 49–51 – right antenna, dorsal aspect, 52–55 – ultimate joint of labial palp, dorsolateral aspect, 56 – third and fourth maxillary joint, dorsal aspect). 49 – *Tricholicinus setosus* J. Sahlberg, L3, 50 – *Molops piceus* (Panzer), L1, 51 – *Badister bullatus* (Schrank), L3, 52 – *Callistus lunatus* (F.), L3, 53 – *Pterostichus strenuus* (Panzer), L1, 54 – *Carabus circassicus* (Gangelbauer), L2, 55,56 – *Epaphius secalis (Paykull)*, L3 (52 after Makarova & Makarov (1996), other – orig.)

ops, *Abax*; Licinini: *Tricholicinus* – Figs 49, 50); 3) separation of the upper part of the 3rd antennae segment (*Badister* – Fig. 51., probably also *Amblystogenium* – as from incomplete description by Womersley 1937); and 4) indistinct separation of distal segment of labiale and maxillary palps into 2–3 segments (Trechini – Figs 55, 56, some Clivinini). These variants are realized only in predatory forms, both open-living and typical geobionts.

Structures, used in the feeding process

Following Striganova (1966) mouthpart apparatus of Carabidae larvae is characterized as cutting or puncture-cutting. Morphological feeding-related adaptations are realized in carabid larvae mainly at the level of macrostructures, such as nasale and mouth appendages. Chaetome modifications only follow modifications of mouthparts, and happen in specific sensory apparatus for catching (but not for locating) the prey, and in mechanical structures for manipulating with food.

Analysis of mouthpart chaetome enables to distinguish in carabid larvae three main morphological types which can be considered as the extreme achievements in adaptive radiation of feeding-related structures.

a) Catching apparatus. Here protrusion of sensory structures which control quick closing of mandibles at the contact with prey are characteristic (Spence & Sutcliffe 1982): elongation of nasale teeth carrying $FR_{10,11}$ seta and of front corners of paraclypeus, enlarged MN_2. gMX seta with small number of thick long setae located mostly in the distal part of stipes (Fig. 57). This type is typical for larvae of *Notiophilus*, *Loricera*, *Leistus*, *Galerita*. Usually it is accompanied by restructurisation of sensory sensillae complex for increase of sensory active zone. Interaction of sensory and feeding-related structures during hunting of these larvae has been described in details (Bauer 1979, Spence & Sutcliffe 1982, Bauer & Kredler 1988).

b) Cutting-filtering type of mouthpart structure is common for predatory larvae of ground-beetles. This type is characterized by moderate development of $FR_{10,11}$ seta, and by presence of Y-shaped setae functioning as food filters in gMX. In representatives of Lebiini tribe which have reduced gMX seta filtration function is carried by penicillus. The extreme development of this type is found in larvae of Licinini and Panagaeini tribes, which have rows of numerous teeth (Figs 58, 60–62) of different or igin almost on all mouthpart appendages.

c) Chewing-cracking type of mouthpart structure is developed in forms which feed on solid food. This type is characterized by smaller $FR_{10,11}$ setae (often they are completely hidden in the massive multirow nasale), and by differentiated apical group of thick setae in gMX (Fig. 59) or cone-like lobe on cardo. Almost all Zabrini and Harpalini, *Ortogonius* are typical representatives of this type.

Quite important, that separate functional blocks of chaetome are not equal as related to their possibility for modification. Thus, subordinate character of feeding-related chaetome to relevant macro-morphological structures is obvious. At the same time covering complex is modified rather autonomously.

Presence of similar chaetome modifications in representatives of different carabid taxa proves its significant functional flexibility and large adaptive importance.

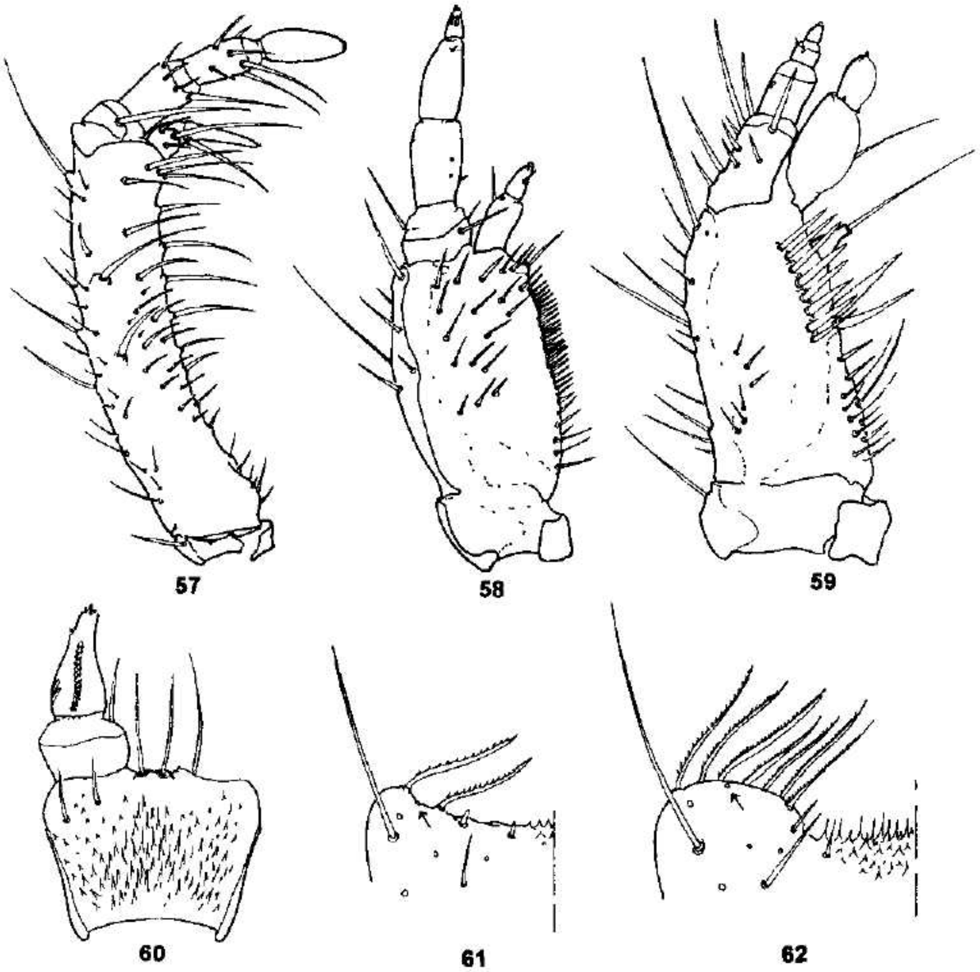
Morphological restructurisations of chaetome and their significance

Generalizing all the above it is possible to reveal two main processes of chaetome changes: changes in number of elements or qualitative transformations (uniformation and diversification of sensillae).

Changes in number of elements

Reduction is observed in carabid larvae rather rarely. Two kinds of this process can be distinguished:

1. Disappearance of certain chaetome elements. Usually it is observed within genera, or even in smaller taxonomic units. Although chaetome remains typical for the group in whole, some species can lack few elements of „general" structure. These are the examples with absence of PR_{13} seta in several *Amara* species, setae MX_{11} and MX_{12} in some Callistini. Reduction of one certain sensillae very rarely can act as diagnoses for higher taxa (for example Brachinini, Callistini).



Figs 57–58 Structure and chaetotaxy of carabid larvae mouthparts 57–59 – different types of maxillae (57 – catch type, 58 – filtration type and 59 – crush type), dorsal aspect of left maxilla, 60–62 – filtering structures (60 – labium, dorsal view, left palp not shown, 61,62 – left paraclypeus and adjacent part of nasale, dorsally) 57 – *Galerita feai* Bates, L3, 58 – *Panagaeus cruxmajor* (L.), L3, 59 – *Orthogonius ?acutangulus* (Chaudoir), L3, 60, 61 – *Badister bullatus* (Schrank), L3, 62 – *Licinus depressus* (Paykull), L1. Arrow points to FR_8 conical sensille.

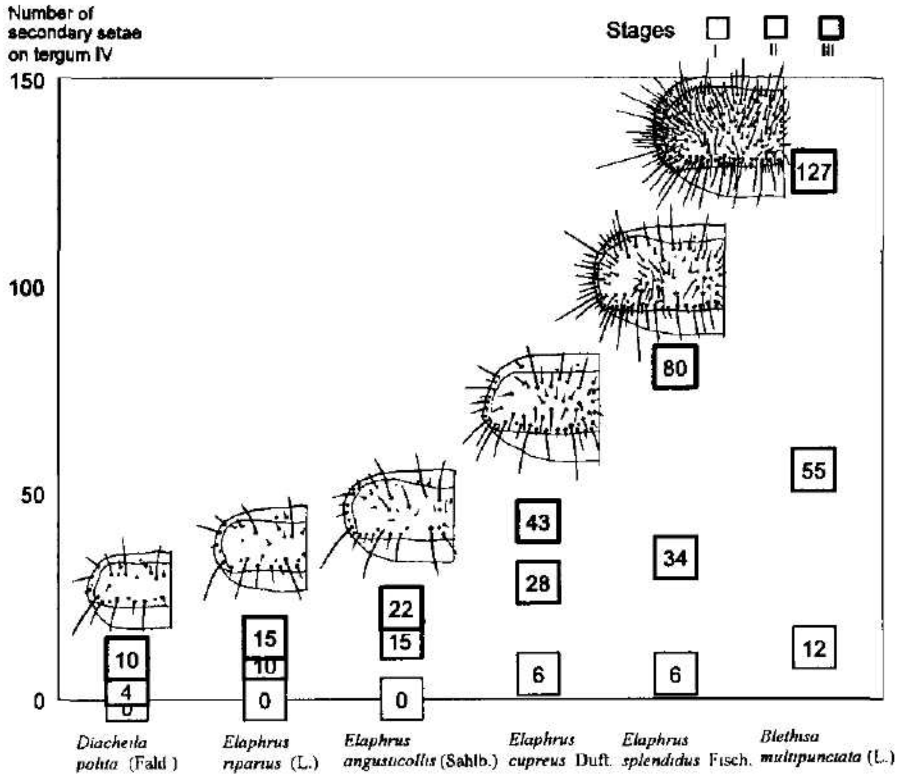


Fig. 63. Chaetome changes of abdominal tergit IV during ontogenesis of larvae in tribe Elaphrini.

2. Disappearance of smaller or larger complexes of seta and pores. Most often this kind of reduction is connected with overall enlargement and thickening of cuticle (tribes Carabini, Cychrini). As a rule oligomerisation involves chaetome of dorsal, more rarely of pleural and ventral sclerites. There reduction in number of „general" seta coincides with appearance of numerous small conical sensillae, so that overall density of sensory elements on larval body does not decrease (Table 1).

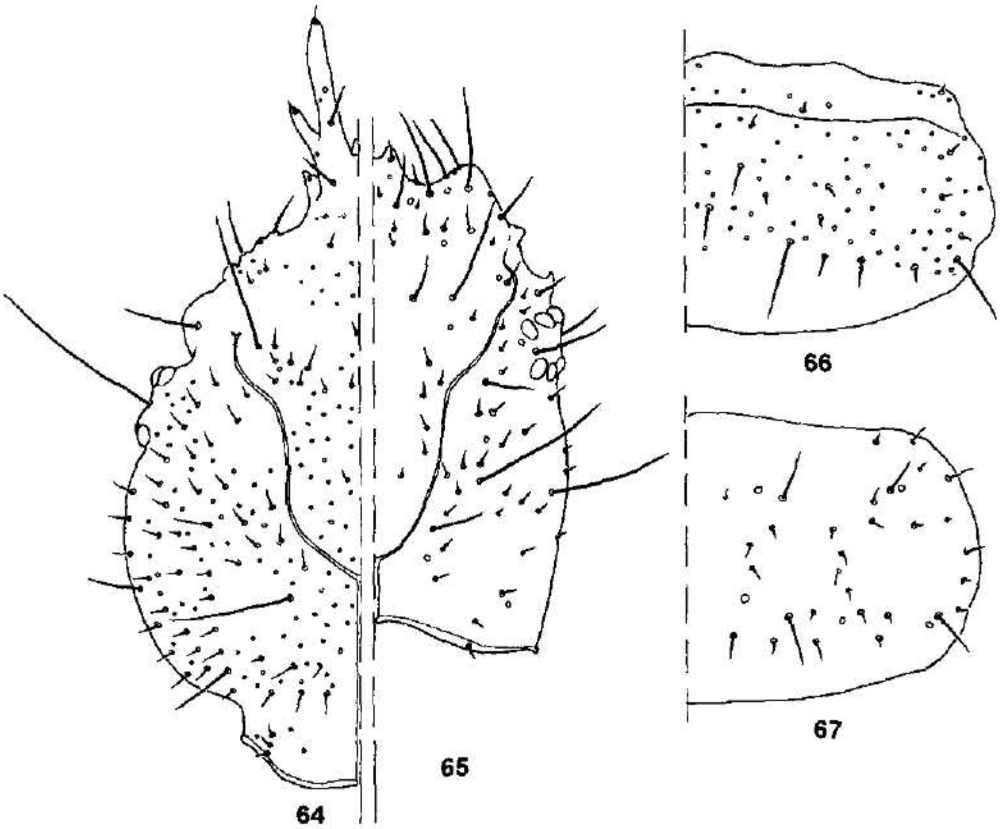
In some cases reduction of chaetome is natural. Thus, in larvae of Trechitae supertribe (Grebennikov 1995) lacking structures are those connected mostly with posterolateral corners of tergites.

Processes of reduction result in what could be called oligochaetosis, or in extreme cases achaetosis. The latter has recently only one described example, that is very simplified chaetome of larvae of *Cychrus*.

Now it is quite difficult to define the reasons for chaetome reduction. It seems obvious that minimization of body size does not lead directly to chaetome reduction. Anyway, in smallest carabid larvae (Trechitae, many Lebiini, I instar of Brachinini) all variants of chaetome deve-

lopment can be observed, i. e. from complete (*Microlestes*, *Synthomus*) to more or less reduced (*Brachinus*, Trechitae, especially Trechodini – Grebennikov 1996). Adaptive role of reduction is rather doubtful, and no correlations were found with larvae habits either. Absence of some elements can be in principle the result of mutation. Reduction of large setal complexes probably has different explanation. Two possible reasons could be suggested: (1) laconization of chaetome during phylogenesis, (2) general simplification of larvae organization due to disembryonization of development. The latter suggestion can be proved by noticeable reduction of chaetome in larvae with one claw (supertribe Trechitae, genus *Brachinus*), which indicates on emerging from eggs on earlier stages of development (Tikhomirova 1992). It could be possible to evaluate the reduction of sensillae numbers during evolution only after the ancestral state of chaetome (see below) is identified; thus recently it cannot yet be done.

Multiplication (polymerization) of sensillae is more or less characteristic to larvae of most carabids. This process is realized in ontogenesis almost always, when single sensillae of first instar larvae are altered in consequent instars with groups of homologous formations (Fig. 26). However quite often happens that already at the first stage of larvae development number of



Figs 64–67. Cases of primitive (64, 66) and advanced (65, 67) of chaetome patterns. 64, 65 – cephalic capsule, dorsally, 66, 67 – IV abdominal tergite, dorsally. 64, 66 – *Leistus terminatus* (Hellwig in Panzer), L2, 65, 67 – *Paradromius linearis* (Olivier), L3.

sensillae is noticeably larger. This tendency is most expressed in representatives of Helluonini and Anthiini tribes, whose „primary" chaetome consists only of groups of seta.

This result with increased number of sensillae we call polychaetosis (or hyperchaetosis).

Diversification or uniformation

Multiplication of chaetome elements can coincide with appearance of new kinds of sensillae compared to original ones. Therefore two variants of hyperchaetosis (Figs 30, 31) are distinguished: (1) homochaetosis, when new formations are analogous to original structures and do not differ in size from them, and (2) heterochaetosis, when new sensillae are either noticeably smaller in size than original ones, or belong to different sensillae type. In the latter case (for example additional phylloid seta on pleurites of *Carabus*, bacilliform seta of *Chlaenius*) it is worth to distinguish ordinary (basic) chaetome corresponding to „general" type, and idiochaetome, which includes new formations. Homochaetosis of larvae usually appears due to absence of distinct morphological boundary between groups of macro- and mesoseta.

Homochaetosis is observed in carabid larvae rather rarely, and is connected with specialization to pawing of loose substrates (Anthiini, some Zabrini).

Heterochaetosis is more common type of chaetome changes. It is realized differently in separate groups of carabid larvae. Thus, representatives of Callistini, Oodini, Panagaeini tribes, many Lebiini have firmly differentiated trichoid chaetome: large „general" seta are well noticeable at the background of numerous evenly distributed small secondary seta. Formation of specialized spine-like seta on abdominal tergites (Carabini: *Callisthenes*, Harpalini: *Daptus*, Orthogonini: *Orthogonius*) belongs in principle also to this type of heterochaetosis. In Harpalini and several Zabrini larvae secondary seta are distributed unevenly, they form more or less distinct groups sometimes located in depressions of cuticle. Usually these are transversal rows on forehead and tergites, and longitudinal rows on parietal sclerites, they are more expressed in pawing (excavating) forms. Together with development of secondary seta increase in number of basi- and coeloconical sensillae is usually observed.

Development of idiochaetome is obviously connected in most cases with advanced specialization of larvae. These are for example drusy setae of myrmeco- or termitophilous forms (*Metrius*, *Graphipterus*, *Pseudomorpha*), bacilliform setae in halophilous, digitiform of phylloid setae in some *Carabus*. Larvae of *Asaphidion* with numerous druseform setae, are probably the only exception from this rules, although almost nothing is known yet about their habits in nature.

Very peculiar chaetome has been found in representatives of Orthogonini and Cychrini tribes: numerous microtrichia which are not related to sensory function are developed on dorsal sclerites or on intersclerite membranes (Fig. 44). This similarity is even more interesting if one takes into account that larvae of *Cychrus* genus are specialized surface-dwelling mollusc predators with very simplified „general" chaetome, while larvae of *Orthogonius* genus are termitophilous with well developed heterochaetosis. The presence of this feature in representatives of non-allied tribes indicates on its convergent origin, and thus proves relatively independent evolution of chaetome elements.

Described ways of chaetome restructurisation form logically a natural row from simple forms of chaetome organization to complex ones. At the level of certain taxa this row is certainly determined both by ontogenetic development and simultaneously by phylogenetic trends. Thus, on the example of Elaphrini tribe larvae (Fig. 63) it can be observed, that very complicated chaetome of most specialized forms is connected with „general" type by continuous row of onto-phylogenetic anabolic modifications. Similar schemes could be produced for other taxa and for other features as well (for example IX–X segments in *Clivina*, heterochaetosis in Callistini and

Lebiini (*Cymindis*), some Calleidini (*Parena* – see Habu 1981), dorsal chaetome of Zabrini etc.). However, even among evolutionary advanced groups of carabids (Pterostichini, Harpalini) chaetome structure which is close to general one often prevails; it is very similar to chaetome of upper Jura larvae of *Carabolarva* (which belongs probably to allied Eodromeinae group – Makarov 1995). Therefore it can be supposed that simplification or increased complexity of chaetome does not reflect general phylogenetic trends in the whole family.

Comparison of chaetome structure in larvae from tribes which are traditionally considered as most primitive among carabids (Nebriini, Carabini) has revealed one common peculiarity: very little difference in the structure of „primary" and „secondary" sensillae (especially of campaniform sensillae, which sometimes cannot be distinguished from each other – Figs 64, 66*), and relatively larger variability in their localization and distribution. On the contrary, in evolutionary progressive taxa these differences are pronounced, and characteristic groups of seta and sensillae of different types are more distinct (Figs 65, 66). This trend can be observed in the structures of three different functional blocks – covering, sensory, and locomotory.

Therefore it can be suggested that evolution of carabid larvae chaetome has in the background the principle of optimization of sensory functions, expressed morphologically in stabilization of chaetome and in formation of constant complexes of different sensillae (like trichoid FR_2 – campaniform FR_b). At the background of this main trend subordinate morphological peculiarities, such as oligomerisation of chaetome, homo- and heterochaetosis, are realized in different taxa. Ways of modifications depend on certain taxa, and their analysis can be used for elaboration of relationship scheme in carabids. Phylogenetic taxonomic aspects of this problem will be covered in a separate paper. Finally it is worth to add that all these trends can be revealed based on descriptions of elder instar larvae as well; this contradicts to the usual practice of recent decade to describe only 1st instar larvae.

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* The larvae of two species invoked for comparison are similar in way of living (agile, living in surface, hibernate) and in body size, boths species collected in one biotope.

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APPENDIX

MATERIAL EXAMINED

COLEOPTERA
ADEPHAGA

HALIPLIDAE
Haliplus sp.

DYTISCIDAE
Hyphydrus ovatus (L., 1761), *Hydroporus* sp., *Ilybius fuliginosus* (Fabricius, 1762), *Acilius canaliculatus* (Nicolai, 1822)

CARABIDAE
Cicindelinae

Cicindelitae

Megacephalini *Megacephala euphratica* Dejean, 1822

Cicindelini *Cicindela (Eumecus) germanica* L., 1758, *C. (Cephalota) deserticola* Faldermann, 1836, *C. (Cicindina) arenaria* Fuesslin, 1775, *C. (C.) sublacerata* Solsky, 1874, *C. (Lophyridia) fischeri* Adams, 1817, *C.* (s. str.) *hybrida* L. 1758, *C.* (s. str.) *albopilosa* Dokhturoff, 1885, *C.* (s. str.) *sylvatica* L. 1758, *C.* (s. str.) *soluta* Latreille et Dejean, 1822, *C.* (s. str.) *campestris* L. 1758, C. (s. str.) *turkestanica* Ballion, 1876, *C.* (s. str.) *clypeata* Fischer von Waldheim, 1821

Omophroninae
Omophronini *Omophron* (s. str.) *limbatus* (Fabricius, 1776)

Carabinae*

Nebriitae

Pelophilini *Pelophila borealis* (Paykull, 1790)

Nebriini *Leistus* (s. str.) *ferrugineus* (L., 1758), *L.* (s. str.) *terminatus* (Hellwig in Panzer, 1793), *L.* (s. str.) *fulvus* Chaudoir, 1846, *L.* (s. str.) *niger* Gebler, 1847, *Nebria (Eunebria) nigerrima* Chaudoir, 1846, *N. (E.) psammophila* Solsky, 1874, *N. (E.) kirgisica* Shilenkov, 1982, *N. (Paranebria) livida* (L., 1758), *N. (Boreonebria) frigida* R. Sahlberg, 1844, *N. (B.) rufescens* (Strom, 1768), *N. (B.) nivalis* (Paykull, 1798), *N. (B.) subdilatata* Motschulsky, 1844, *N.* (s. str.) *brevicolis* (Fabricius, 1792), *N. (Alpaeus) bonelli* (Adams, 1817), *N. (A.) ?commixta* Chaudoir, 1850

Notiophilitae

Notiophilini *Notiophilus* (s. str.) *aquaticus* (L., 1758), *N.* (s. str.) *impressifrons* Morawitz, 1862, *N.* (s. str.) *palustris* (Duftschmidt, 1812), *N.* (s. str.) *germinyi* Fauvel, 1863, *N. (Latviaphilus) biguttatus* Fabricius, 1779, *N. (L.) reitteri* Spath, 1899, *N. (Makarovius) rufipes* Curtis, 1829

Carabitae

Carabini *Calosoma* (s. str.) *sycophanta* (L., 1758), *C. (Acalosoma) inquisitor* (L., 1758), *C. (Campalita) auropunctatum* (Herbst, 1784), *C. (C.) chinense* Kirby, 1817, *C.* (Caminara) *denticolle* Gebler, 1833, *C. (C.) reitteri* Roeschke, 1897, *C. (Charmosta) investigator* (Illiger, 1798), *C. (C.) lugens* Chaudoir, 1869, *C.* (s. str.) *breviusculus* Mannerheim, 1830, *Callisthenes* (s. str.) *elegans* Kirsch, 1859, *C.* (s. str.) *semenovi* Motschulsky, 1859, *C.* (s. str.) *kuschakewitschi* Ballion 1870, *C.* (s. str.) *pseudocarabus* Semenov, 1928, *C.* (s. str.) *regelianus* Morawitz, 1886, *C.* (s. str.) *usgentensis* Solsky, 1874, *Carabus (Acrocarabus) guerini* Fischer von Waldheim, 1842, *C. (A.) callisthenoides* Semenov, 1888, *C. (Eucarabus) arvensis* Herbst, 1784 *C. (E.) stscheglowi* Mannerheim, 1827, *C. (E.) billbergi* Mannerheim, 1827, *C. (E.) cumanus* Fischer von Waldheim, 1823, *C. (E.) ullrichi* Germar, 1824, *C. (Autocarabus) obsoletus* Sturm, 1815, *C. (A.) auratus* L., 1761, *C. (A.) cancellatus* Illiger, 1798, *C.* (s. str.) *granulatus* L., 1758, *C.* (s. str.) *sculpturatus* Menetries, 1832, *C.* (s. str.) *menetriesi* Faldermann, 1827, *C. (Morphocarabus) tarbagataicus* Kraatz, 1878, *C. (M.) aeruginosus* Fischer von Waldheim, 1822, *C. (M.) hummeli* Fischer von Waldheim, 1823, *C. (M.) henningi* Fischer von Waldheim, 1817, *C. (M.) odoratus* Motschulsky, 1844, *C. (M.) karpinskii* Khryzhanovskij et Matveev, 1993, *C. (M.) michailovi* Kabak, 1992, *C. (M.) mestscherjakovi*

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* Larvae belong to tribes Opishiini, Collyrini, Ctenostomatini, Pamborini, Migadopini, Promecogthini, Siagonini Enceladini, Pseudomorphini, Metriini, Psydrini, Peleciini, Ablystomini, Cnemacanthini, Odacanthini, Lachnophorini, Zuphiini, Tetragonoderini Helluodini, Mormolycini, subfamily Paussinae and family Trachypachidae are known to me only on publication

Lutshnik, 1924, *C.* (*M.*) *regalis* Fischer von Waldheim, 1822, *C.* (*M.*) *excellens* Fabricius, 1798, *C.* (*M.*) *hampei* Kuster, 1846, *C.* (*Leptinocarabus*) *venustus* Morawitz, 1862, *C.* (*L.*) *wulffiusi* Morawitz, 1862, *C.* (*Trachycarabus*) *besseri* Fischer von Waldheim, 1822, *C.* (*T.*) *bosphoranus* Fischer von Waldheim, 1823, *C.* (*T.*) *haeres* Fischer von Waldheim, 1823, *C.* (*T.*) *campestris* Fischer von Waldheim, 1822, *C.* (*T.*) *scabriusculus* Olivier 1795, *C.* (*T.*) *estreicheri* Fischer von Waldheim, 1822, *C.* (*T.*) *latreillei* Fischer von Waldheim, 1822, *C.* (*T.*) *mandibularis* Fischer von Waldheim, 1827, *C.* (*T.*) *sibiricus* Fischer von Waldheim, 1822, *C.* (*Ophiocarabus*) *aeneolus* Morawitz, 1886, *C.* (*Cryptocarabus*) *lindemanni* Ballion, 1878, *C.* (*C.*) *subparallelus* Ballion, 1878, *C.* (*Mimocarabus*) *maurus* Adams, 1817, *C.* (*M.*) *roseni* Reitter, 1897, *C.* (*Archicarabus*) *nemoralis* O. F. Muller, 1764, *C.* (*A.*) *victor* Fischer von Waldheim, 1836, *C.* (*Limnocarabus*) *clathratus* L., 1761, *C.* (*Homoeocarabus*) *maeander* Fischer von Waldheim, 1822, *C.* (*Hemicarabus*) *macleayi* Dejean, 1826, *C.* (*H.*) *nitens* L., 1758, *C.* (*H.*) *tuberculosus* Dejean, 1829, *C.* (*Aulonocarabus*) *canaliculatus* Adams, 1812, *C.* (*A.*) *careniger* Chaudoir, 1863, *C.* (*A.*) *kurilensis* Lapouge, 1913, *C.* (*A.*) *truncaticollis* Eschscholtz, 1833, *C.* (*Leptocarabus*) *arboreus* Lewis, 1882, *C.* (*Asthenocarabus*) *opaculus* Putzeys, 1875, *C.* (*Diocarabus*) *loschnikovi* Fischer von Waldheim, 1823, *C.* (*D.*) *slovtzovi* Mannerheim, 1849, *C.* (*D.*) *massagetus* Motschulsky, 1844, *C.* (*D.*) *beybienkoi* Kryzhanovskij, 1973, *C.* (*Pachycarabus*) *mutator* Reitter, 1883, *C.* (*P.*) *koenigi* Ganglbauer, 1886, *C.* (*P.*) *staehlini* Adams, 1817, *C.* (*Orinocarabus*) *linnei* Panzer, 1812, *C.* (*O.*) *silvestris* Panzer, 1793, *C.* (*Hadrocarabus*) *problematicus* Herbst, 1786, *C.* (*Oreocarabus*) *glabratus* Paykull, 1790, *C.* (*O.*) *hortensis* L., 1758, *C.* (*O.*) *cribratus* Quensel, 1806, *C.* (*Ulocarabus*) *stschurowskii* Solsky, 1874, *C.* (*U.*) *theanus* Reitter, 1895, *C.* (*Semnocarabus*) *erosus* Motschulsky, 1865, *C.* (*S.*) *carbonicolor* Morawitz, 1886, *C.* (*S.*) *regulus* Dohrn, 1882, *C.* (*S.*) *transiliensis* Semenov, 1896, *C.* (*Tomocarabus*) *convexus* Fabricius, 1775, *C.* (*T.*) *decolor* Fischer von Waldheim, 1823, *C.* (*T.*) *marginalis* Fabricius, 1794, *C.* (*T.*) *bessarabicus* Fischer von Waldheim, 1823, *C.* (*T.*) *scabripennis* Chaudoir, 1850, *C.* (*Scambocarabus*) *kruberi* Fischer von Waldheim, 1822, *C.* (*Pachystus*) *hungaricus* Fabricius, 1792, *C.* (*P.*) *cribellatus* Adams, 1812, *C.* (*Hygrocarabus*) *variolosus* Fabricius, 1787, *C.* (*Chaetocarabus*) *intricatus* L., 1761, *C.* (*Platycarabus*) *fabricii* Panzer, 1812, *C.* (*Panthophyrtus*) *turcomanorum* Thieme, 1881, *C.* (*P.*) *brachypedilus* Morawitz, 1886, *C.* (*Megodontus*) *vietinghoffi* Adams, 1812, *C.* (*M.*) *violaceus* L., 1758, *C.* (*M.*) *aurolimbatus* Dejean, 1929, *C.* (*M.*) *stroganowi* Zoubkoff, 1837, *C.* (*M.*) *gyllenhali* Fischer von Waldheim, 1827, *C.* (*M.*) *exaratus* Quensel, 1806, *C.* (*M.*) *septemcarinatus* Motschulsky, 1840, *C.* (*Aînocarabus*) *kolbei* Roeschke, 1897, *C.* (*A.*) *avinovi* Semenov, 1932, *C.* (*Pachycranion*) *imperialis* Fischer von Waldheim, 1823, *C.* (*P.*) *schoenherri* Fischer von Waldheim, 1822, *C.* (*Carabulus*) *leachi* Fischer von Waldheim, 1823, *C.* (*C.*) *ermaki* Lutshnik, 1924, *C.* (*Chrysocarabus*) *auronitens* Fabricius, 1792, *C.* (*Acoptolabrus*) *constricticollis* Kraatz, 1886, *C.* (*A.*) *schrencki* Motschulsky, 1860, *C.* (*A.*) *lopatini* Morawitz, 1886, *C.* (*Sphodristocarabus*) *armeniacus* Mannerheim, 1830, *C.* (*S.*) *adamsi* Adams, 1817, *C.* (*S.*) *bohemanni* Menetries, 1832, *C.* (*Cechenochilus*) *boeberi* Adams, 1817, *C.* (*C.*) *gusevi* Zamotajlov et Koval, 1989, *C.* (*C.*) *heydenianus* Starck, 1889, *C.* (*C.*) *kokujewi* Semenov, 1898, *C.* (*Eotribax*) *hiekei* Kabak et Kryzhanovskij, 1990, *C.* (*E.*) *valikhanovi* Kabak, 1990, *C.* (*Leptoplesius*) *merzbacheri* Hauser, 1922, *C.* (*Cechenotribax*) *petri* Semenov et Znojko, 1932, *C.* (*Cratocechenus*) *akinini* Morawitz, 1886, *C.* (*C.*) *ovtschinnikovi* Gottwald, 1987, *C.* (*C.*) *corrugis* Dohrn, 1882, *C.* (*C.*) *cicatricosus* Fischer von Walheim 1842, *C.* (*C.*) *solskyi* Ballion, 1878, *C.* (*C.*) *balassogloi* Dohrn, 1882, *C.* (*Pseudotribax*) *validus* Kraatz, 1884, *C.* (*P.*) *ferghanicus* Breuning, 1933, *C.* (*Cratophyrtus*) *kaufmanni* Solsky, 1874, *C.* (*C.*) *medvedevi* Kryzhanovskij, 1968, *C.* (*C.*) *puer* Morawitz, 1886, *C.* (*C.*) *jacobsoni* Semenov, 1908, *C.* (*C.*) *redikortzevi* Semenov, 1933, *C.* (*Alipaster*) *pupulus* Morawitz, 1889, *C.* (*Tribax*) *circassicus* Ganglbauer, 1886, *C.* (*T.*) *agnatus* Ganglbauer, 1889, *C.* (*T.*) *titan* Zolotarev, 1913, *C.* (*T.*) *kasbekianus* Kraatz, 1877, *C.* (*T.*) *apschuanus* Rost, 1893, *C.* (*T.*) *biebersteini* Menetries, 1832, *C.* (*T.*) *constantinowi* Starck, 1894, *C.* (*T.*) *retezari* Gottwald, 1980, *C.* (*T.*) *fossiger* Chaudoir, 1877, *C.* (*T.*) *osseticus* Adams, 1817, *C.* (*T.*) *steveni* Menetries, 1832, *C.* (*Microplectes*) *argonautarum* Semenov, 1898, *C.* (*M.*) *convallium* Starck, 1889, *C.* (*M.*) *riedeli* Menetries, 1832, *C.* (*Microtribax*) *kasakorum* Semenov, 1896, *C.* (*Archiplectes*) *daphnis* Kurnakov, 1962, *C.* (*A.*) *protensus* Schaum 1864, *C.* (*A.*) *plasoni* Ganglbauer, 1886, *C.* (*A.*) *faunus* Kurnakov, 1972, *C.* (*A.*) *lennoni* Gottwald, 1985, *C.* (*A.*) *apollo* Zolotarev, 1913, *C.* (*A.*) *satyrus* Kurnakov, 1962, *C.* (*A.*) *polychrous* Rost, 1892, *C.* (*A.*) *rousianus* Gottwald 1985, *C.* (*A.*) *reitteri* Retowski, 1885, *C.* (*A.*) *juenthneri* Reitter, 1899, *C.* (*A.*) *jason* Semenov, 1898, *C.* (*A.*) *starcki* Heyden, 1884, *C.* (*A.*) *edithae* Reitter, 1893, *C.* (*A.*) *kratkyi* Ganglbauer, 1890, *C.* (*A.*) *felicitanus* Reitter, 1893, *C.* (*A.*) *starckianus* Ganglbauer, 1886, *C.* (*A.*) *prometheus* Reitter, 1887, *C.* (*A.*) *basilianus* Starck, 1890, *C.* (*A.*) *miroshnikovi* Zamotajlov, 1990, *C.* (*Lamprostus*) *calleyi* Fischer von Waldheim, 1823, *C.* (*Procrustes*) *coriaceus* L., 1758, *C.* (*P.*) *clypeatus* Adams, 1817, *C.* (*P.*) *talyshensis* Menetries, 1832, *C.* (*Goniocarabus*) *gussakowskii* Kryzhanovskij, 1971, *C.* (*Deroplectes*) *coiffaitianus* Deuve, 1990, *C.* (*D.*) *sphinx* Reitter, 1895, *C.* (*Plesius*) *staudingeri* Ganglbauer, 1886, *C.* (*P.*) *dokhtouroffi* Ganglbauer, 1886, *C.* (*Axinocarabus*) *fedtschenkoi* Solsky, 1874, *C.* (*A.*) *miles* Semenov, 1887, *C.* (*Coptolabrus*) *smaragdinus* Fischer von Waldheim, 1823, *C.* (*Damaster*) *rugipennis* Motschulsky, 1861, *C.* (*Procerus*) *scabrosus* Olivier, 1795, *C.* (*P.*) *caucasicus* Adams, 1817, *C.* (*Eupachys*) *glyptopterus* Fischer von Waldheim, 1827

Cychrini *Cychrus aeneus* Fischer von Waldheim, 1824, *C. caraboides* (L., 1758), *C. semigranosus* Palliardi, 1825, *C. morawitzi* Géhin, 1863

Elaphritae

Elaphrini *Diachetla fausti* Heyden, 1887, *D polita* (Faldermann, 1835), *Blethisa ?tuberculata* Motschulsky, 1844, *B multipunctata* L , 1758, *Elaphrus (Arctelaphrus) lapponicus* Gyllenhall, 1810, *E (Neoelaphrus) splendidus* Fischer von Waldheim, 1828, *E (N) sibiricus* Motschulsky, 1844, *E (N) cupreus* Duftschmid, 1812, *E* (s str) *riparius* (L , 1758), *E (Elaphroterus) angusticollis* R Sahlberg, 1844

Loriceritae

Lorícerini *Loricera* (s str) *pilicornis* (Fabricius, 1775)

Scarititae

Scaritini *Scarites (Distichus) planus* Bonelli, 1813, *S* (s str) *angustus* Chaudoir, 1855, *S* (s str) *eurytus* Fischer von Waldheim, 1825, *S* (s str) *laevigatus* Fabricius, 1792, *S* (s str) *salinus* Dejean, 1859, *S* (s str) *terricola* Bonelli, 1813, *S (Scallophorites) bucida* Pallas, 1776

Clivinini *Clivina fossor* (L , 1758), *C ypsilon* Dejean, 1829

Dyschiriini *Dyschirius arenosus* Stephens, 1827, *D baicalensis* Motschulsky, 1844, *Dyschiriodes (Eudyschirius) globosus* (Herbst, 1783), *D* (s str) *nitidus* (Dejean, 1825), *D* (s str) *?chalceus* (Erichson, 1837), *D* (s str) *nigricornis* (Motschulsky, 1844), *D* (s str) *tristis* (Stephens, 1827)

Broscitae

Broscini *Broscus cephalotes* (L , 1758), *B semistriatus* (Dejean, 1828), *B asiaticus* Ballion, 1870, *B punctatus* (Dejean, 1828), *Miscodera arctica* (Paykull, 1798)

Trechitae

Trechini *Epaphius secalis* (Paykull, 1790), *Trechus quadristriatus* (Schrank, 1781), *T rubens* (Fabricius, 1792), *T goliath* Belousov et Kabak, 1991, *T ?almonius* Reitter, 1903

Tachyini *Tachys* sp , *Tachyta nana* (Gyllenhall, 1810)

Bembidiini *Asaphidion flavipes* (L , 1761), *Bembidion (Bracteon) ?argenteolum* (Ahrens, 1812), *B (Metallina) ?properans* (Stephens, 1829), *B (Notaphus) varium* (Olivier, 1795), *B (Eupetedromus) dentellum* (Thunberg, 1787), *B (Bembidion) quadrimaculatum* (L , 1761), *B (Trichoplataphus) hasti* C Sahlberg, 1827, *B (Ocydromus) femoratum* Sturm, 1825, *B (O) tetracolum* Say, 1823

Pogonini *Pogonus (Pogonoidius) cumanus* Lutshnik, 1916, *P* (s str) *luridipennis* (Germar, 1822)

Patrobitae

Patrobini *Patrobus atrorufus* (Strom, 1768), *P septentrionis* Dejean, 1828, *Diplous depressus* (Gebler, 1829)

Deltomerini *Deltomerus elongatus* Dejean, 1831, *D tibialis* Reitter, 1887

Pterostichitae

Morionini *Morion* sp

Pterostichini *Poecilus* (s str) *cupreus* (L , 1758), *P* (s str) *versicolor* (Sturm, 1824), *P* (s str) *fortipes* Chaudoir, 1850, *P* (s str) *punctulatus* (Schaller, 1783), *Pterostichus (Platysma) niger* (Schaller, 1783), *P (Myosodus) lacunosus* (Chaudoir, 1844), *P (M) variabilis* (Menetries, 1832), *P (Argutor) vernalis* (Panzer, 1796), *P (Melanius) anthracinus* (Illiger, 1798), *P (M) gracilis* (Dejean, 1828), *P (M) nigrita* (Paykull, 1790), *P (Phonias) strenuus* (Panzer, 1797), *P (Cryobius) brevicornis* (Kirby, 1837), *P (C) pinguedineus* Eschscholtz, 1823, *P (Oreoplatysma)* sp , *P (Eurymelanius) caucasicus* Menetriés, 1832, *P (E) chydaeus* (Tschitscherine, 1896), *P (Steropus) aereipennis* Solsky, 1872, *P (S) aethiops* (Panzer, 1797), *P (Steroperis) vermiculosus* Ménétriés, 1851, *P (Bothriopterus) adstrictus* Eschscholtz, 1823, *P (B) quadrifoveolatus* Letzner, 1852, *P (B) oblongopunctatus* (Fabricius, 1787), *P (B) subovatus* Motschulsky, 1862, *P (Morphnosoma) melanarius* (Illiger, 1798), *P (Feronidius) melas* (Creutzer, 1799), *P (Petrophilus) vladivostokensis* Lafer 1980, *P (Stereocerus) rubripes* Motschulsky, 1860, *P (Calopterus) pilosus* (Host, 1789), *Abax parallelopipedus* Piller et Mitterpacher, 1783, *A parallelus* (Duftschmid, 1812), *A schueppeli* Palliardi, 1827, *Molops piceus* (Panzer, 1793)

Sphodrini *Calathus* (s str) *distinguendus* Chaudoir, 1846, *C* (s str) *fuscipes* (Goeze, 1777), *C* (s str) *longicollis* Motschulsky, 1864, *C (Neocalathus) ambiguus* (Paykull, 1790), *C (Neocalathus) erratus* (C Sahlberg, 1827), *C (Neocalathus) melanocephalus* (L , 1758), *C (Neocalathus) micropterus* (Duftschmid, 1812), *C (Dolichus) halensis* (Schaller,

1783), *C* (*Lindrothius*) sp , *Pseudotaphoxenus* sp , *Pseudotaphoxen rufitarsis* (Fischer von Waldheim, 1823), *Taphoxenus* (s str) *gigas* (Fischer von Waldheim, 1823), ***Eremosphodrus dvorshaki*** Casale et Vereschagina, 1986, ***Laemostenus* (*Antisphodroides*) *koenigi*** (Reitter, 1887), *L* (*Antisphodroides*) *tschitscherini* Semenov, 1908, *L* (*A*) *ljovushkini* Vereschagina, 1985, *L* (*Pristonychus*) ***mannerheimi*** Kolenati, 1845, *L* (*P*) *tauricus* Dejean, 1828, *L* (*P*) *terricola* (Herbst, 1783)

Platynini *Agonum* (s str) *rugicolle* Chaudoir, 1846, *A* (s str) *mandli* Jedlička, 1933, *A* (s str) *marginatum* (L , 1758), *A* (s str) *muelleri* (Herbst, 1784), *A* (s str) *sexpunctatum* (L , 1758), *A* (s str) *viduum* (Panzer, 1797), *A* (*Liebherrius*) *alpinum* Motschulsky, 1844, *A* (*Europhilus*) *exaratum* (Mannerheim, 1853), *A* (*E*) *fuliginosum* (Panzer, 1809), *A* (*E*) *thoreyi* (Dejean, 1828), *Platynus* (s str) *assimile* (Paykull, 1790), *Oxypselaphus obscurum* (Herbst, 1784), *Anchomenus dorsalis* (Pontoppidan, 1763), *Olisthopus rotundatus* **(Paykull, 1790)**, ***Synuchus*** **(s str)** *vivalis* (Illiger, 1798), *S* (*Pristodactyla*) *agonus* (Tschitcherine, 1895)

Amarini *Amara* (*Zezea*) *plebeja* (Gyllenhal, 1810), *A* (s str) *aenea* (DeGeer, 1774), *A* (s str) *communis* (Panzer, 1797), *A* (s str) *eurynota* (Panzer, 1797), *A* (s str) *similata* (Gyllenhal, 1810), *A* (*Celia*) *bifrons* (Gyllenhal, 1810), *A* (*C*) *brunnea* (Gyllenhal, 1810), *A* (*C*) *ingenua* (Duftschmid, 1812), *A* (*Paracelia*) *quenseli* (Schonherr, 1806), *A* (*Oreoamara*) *cordicollis* Menetriés, 1832, *A* (*Bradytus*) *apricaria* (Paykull, 1790), *A* (*B*) *fulva* (O F Muller, 1776), *A* (*B*) *majuscula* (Chaudoir, 1850), *A* (*Percosia*) *equestris* (Duftschmid, 1812)
Harpalodema lutescens Reitter, 1888, *Curtonotus* (s str) *alpinus* (Paykull, 1790), *C* (s str) *aulicus* (Panzer, 1797), *C* (s str) *convexiusculus* (Marsham, 1802), *C* (s str) *gr miser* Tschitscherine, 1899, *Zabrus* (s str) *morio* Menetries, 1832, *Z* (s str) *tenebrioides* (Goeze, 1777), *Z* (*Pelor*) *spinipes* (Fabricius, 1798), *Z* (*P*) *trinii* Fischer von Waldheim, 1817, *Z* ***(Eutroctes) aurichalceus*** Adams, 1817

Harpalitae

Harpalini *Anisodactylus* (s str) *binotatus* (Fabricius, 1787), *A* (s str) *signatus* (Panzer, 1797) *Bradycellus* (*Tachycellus*) *glabratus* (Reitter, 1894), *Dicheirotrichus* (s str) *gustavii* Crotch, 1871, *Stenolophus* (s str) *mixtus* Herbst, 1784, *Acupalpus* (s str) *parvulus* (Sturm, 1885), *Daptus pictus* Fischer von Waldheim, 1824, *Harpalus rufipes* (DeGeer, 1774), *H calceatus* (Duft 1812), *H rubripes* (Duftschmid, 1812), *H quadripunctatus* Dejean, 1829, *H ?pumilus* (Sturm, 1818), *H zabroides* Dejean, 1829, *H froelichi* Sturm, 1818, *H latus* (L , 1758), *H xanthopus* Gemminger et Harold, 1868, *H affinis* (Schrank, 1781), *H distinguendus* (Duftschmid, 1812), *Acinopus* (s str) *picipes* (Olivier, 1795), *A* (*Osimus*) *ammophilus* Dejean 1829, *Ophonus* (*Metophonus*) *nitidulus* Stephens, 1828, *O* (*Metophonus*) *puncticollis* (Paykull, 1798), *O* (*Hesperophonus*) *azureus* (Fabricius, 1775), *O* (s str) *stictus* Stephens, 1828, *Liochirus cycloderus* (Solsky, 1874), *Machozethus lehmanni* (Menetries, 1849), *Chilotomus tschitscherini* Semenov, 1903

Perigonitae

Perigonini *Perigona ?nigrifrons* Motschulsky, 1861

Panagaeitae

Panagaeini *Panagaeus cruxmajor* (L , 1758), *Tefflus ?juvenilis muansanus* Kolbe, 1897

Callistitae

Callistini *Epomis dejeani* Dejean et Boisduval, 1830, *Dinodes decipiens* (Dufour, 1820), *Chlaenius* (*Stenochlaenius*) *coeruleus* (Steven, 1809), *C* (*Chlaenites*) *spoliatus* (Rossi, 1790), *C* (s str) *festivus* (Panzer, 1796), *C* (s str) *flavicornis* Fischer von Waldheim, 1842, *C* (*Chlaenius*) *pallipes* Gebler, 1823, *C* (*Chlaeniellus*) *nitidulus* (Schrank, 1781), *C* (*C*) *tibialis* Dejean, 1826, *C* (*C*) *nigricornis* (Fabricius, 1787), *C* (*C*) *vestitus* (Paykull, 1790), *C* (*C*) *tristis* (Schaller, 1783), *C* (*Agostenus*) *alutaceus* Gebler, 1829, *C* (*Pelasmus*) *costulatus* Motschulsky, 1859

Oodini *Oodes* (*Oodes*) *helopioides* (Fabricius, 1792)

Licinini *Licinus* (s str) *depressus* (Paykull, 1790), *L* (s str) *cassideus* (Fabricius, 1792), *Tricholicinus setosus* J Sahlberg, 1880, *Badister* (s str) *bullatus* (Schrank, 1798), *B* (*Baudia*) *?dilatatus* (Chaudoir, 1837)

Masoreitae

Masoreini *Masoreus wetterhalli* (Gyllenhal, 1813)

Corsyrini *Corsyra fusula* (Steven in Dejean, 1825), *Discoptera komarovi* Semenov, 1889

Lebiitae

Lebiini *Demetrias* (s str) *monostigma* Samouelle, 1819, *Dromius* sp , *Paradromius* (*Manodromius*) *linearis* (Olivier, 1795), *Syntomus* ?*dilutipes* Reitter, 1887, *S truncatellus* (L , 1761), *Charopterus paracenthesis* (Motschulsky, 1889), *Microlestes minutulus* (Goeze, 1777), *Microlestes* sp , *Cymindis* (s str) *angularis* (Gyllenhal, 1810), *C* (s str) *axillaris* (Fabricius, 1794), *C* (s str) *humeralis* (Fourcroy, 1785), *C* (s str) *lineata* (Quensel, 1806), *C* (s str) *picta* (Pallas, 1771), *C* (*Paracymindis*) *mannerheimi* Gebler, 1843, *C* (*Menas*) *impressa* Reitter, 1893, *C* (*Tarsostinus*) *lateralis* Fischer von Waldheim, 1821, *C* (*Tarulus*) *vaporariorum* (L , 1758)

Orthogonini *Orhtogonius* ?*acutangulus* Chaudoir, 1852

Anthiini *Anthia mannerheimi* Chaudoir, 1842, *A* ?*massilicata stygne* Kolbe, 1906

Helluodini *Helluodes taprobanae* Westwood, 1834

Galeritini *Galerita feai* Bates, 1883, *Galerita* sp

Dryptini *Drypta dentata* (Rossi, 1790)

Brachininae

Brachinini *Brachinus crepitans* (L , 1758), *B* ?*explodens* Duftschmid, 1812

POLYPHAGA

HYDROPHILIDAE
Helophorus aquaticus (L , 1758), *Helophorus* spp , *Berosus* ?*signaticollis* (Charpentier, 1825), *Hydrobius fuscipes* (L , 1758)

STAPHYLINIDAE
Oxytelus sp , *Lathrobium* sp , *Philonthus* sp , *Ontholestes* sp , *Tachynus* sp

HISTERIDAE
Margarinotus sp , *Paromalus* sp

DRYLIDAE
Drylus sp

CANTHARIDAE
Cantharis sp , *Rhagonycha* sp

ELATERIDAE
Athous sp , *Selatosomus* sp , *Agriotes obscurus* (L , 1758)

TENEBRIONIDAE
Pedinus sp , *Pisterotarsa* sp

NEUROPTERA

OSMYLIDAE
Osmylus sp

ASCALAPHIDAE
Ascalaphus sp

MYRMELEONIDAE
Myrmeleonidae gen sp

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Review of the Palaearctic larvae of the genus *Stenolophus* (Coleoptera: Carabidae: Harpalini)

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Abstract A review of the Palaearctic larvae of the genus *Stenolophus* Stephens, 1828 is given All larval instars of *Stenolophus* (s str) *persicus* Mannerheim, 1844 are described for the first time Differential diagnoses of the subgenera *Stenolophus* (s. str), *Astenolophus* Habu, 1973, *Egadroma* Motschulsky, 1855 and the genus *Stenolophus*, as well as the keys to the subgenera and species based on first, second and third larval instars characters are given Possible phylogenetical relationships of the species of the genus, based on larval characters, are discussed

Larval morphology, key to all larval instars, Carabidae, *Stenolophus*, Palearctic region

INTRODUCTION

The genus *Stenolophus* includes 60 to 140 species worldwide, reflecting different concepts of different researchers. Lindroth (1968) subdivided the genus into two subgenera (*Stenolophus* s. str. and *Agonoderus* Dejean, 1829) and one species group. Habu (1973) and Noonan (1976) treated it in broader sense: with five subgenera (including *Egadroma*) and one species group. Kataev (in Kryzhanovskij et al., 1995) followed this concept, but Kryzhanovskij (1983), on the other hand, considered *Egadroma* as a sepa rate genus.

Larval characters are useful for solving the controversial questions about the taxonomy at specific level and about the relationships of the subgenera of this genus. Within the subtribe Stenolophina the larvae of the genus *Stenolophus* are best known (Schiödte 1867, Bryson & Dillon 1941, Larsson 1941, Emden 1942, Raynaud 1944, Chu 1945, Sharova 1958, Habu & Sadanaga 1961, 1965, 1970, Kirk 1972, Habu 1973, Hůrka 1975, Thompson 1979, Arndt 1991, Luff 1993). However, different terminology for larval morphology, used in the descriptions create some problems in assessing the taxonomic relationship both at the species and subgeneric levels. The analyses of larval characters of the Palaearctic species of the nominotypical subgenus by Arndt (1991) show only general phyllogenetic trends.

This paper offers a detailed review of the Palaearctic larvae of the genus *Stenolophus* (sensu Noonan 1976). The descriptions and redescriptions of the species are uniform, and follow those of Bousquet & Goulet (1984). The descriptions of the Nearctic species (Chu 1945) were critically analysed using the sample approach. Possible phylogenetical relationships within the genus, based on larval characters are discussed.

MATERIAL AND METHODS

This study is based on the examination of 40 larvae belonging to eight species: *Stenolophus* (s. str) *teutonus* (Schrank, 1781) – 1 L_3, *S* (s. str) *persicus* Mannerheim, 1844 – 5 L_1, 4 L_2, 1 L_3, *S* (s str.) *discophorus* Fischer von Waldheim, 1823 – 4 L_1, 2 L_3, *S* (s. str) *connotatus* Bates, 1873 – 1 L_3, *S.* (s str.) *propinquus* A. Morawitz, 1862 – 1 L_1, *S* (s str) *mixtus*

(Herbst, 1784) – 15 L_1, 3 L_2, 1 L_3, *S.* (*Astenolophus*) *fulvicornis* Bates, 1873 – 1 L_3 and *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann, 1823) – 1 L_3. The larvae of *S. persicus*, *S. discophorus* and *S. mixtus* were obtained from adults kept during 1990–1991 under laboratory conditions, as well as the larvae of *S. persicus*, *S. discophorus* and *S. mixtus*, received from D. N. Fedorenko (Institute of Ecology and Evolution Problems, Moskow, Russia), S. V. Utjanskaja (Rostow Pedagogical Institute, Rostow-Don, Russia) and A. G. Koval (All-Russian Institute of Plant Protection, Pushkin, Russia). The larvae of *S. connotatus*, *S. propinquus*, *S. fulvicornis* and *S. quinquepustulatus* were provided by Takechi Matsumura (National Institute of Agro-Environmental Sciences, Tsukuba, Japan). Data about the larvae of *S.* (s. str.) *iridicolor* Redtenbacher, 1867 and *S.* (*Egadroma*) *difficilis* (Hope, 1845) were taken from Habu (1973), those about the second instar larva of *S.* (s. str.) *discophorus* from Arndt (1991), and those about *S.* (*Agonoderus*) *lineola* (Fabricius, 1792), *S.* (*Agonoderus*) *pallipes* (Fabricius, 1792) and *S.* (s. str.) sp. from Chu (1945). The material used for this study is kept in the collections of the Zoology and Ecology Department, Moskow State Pedagogical University (Moskow, Russia), of the Zoological Institute of the Russian Academy of Science (Sankt-Petersburg, Russia) and of the National Institute of Agro-Environmental Sciences (Tsukuba, Japan).

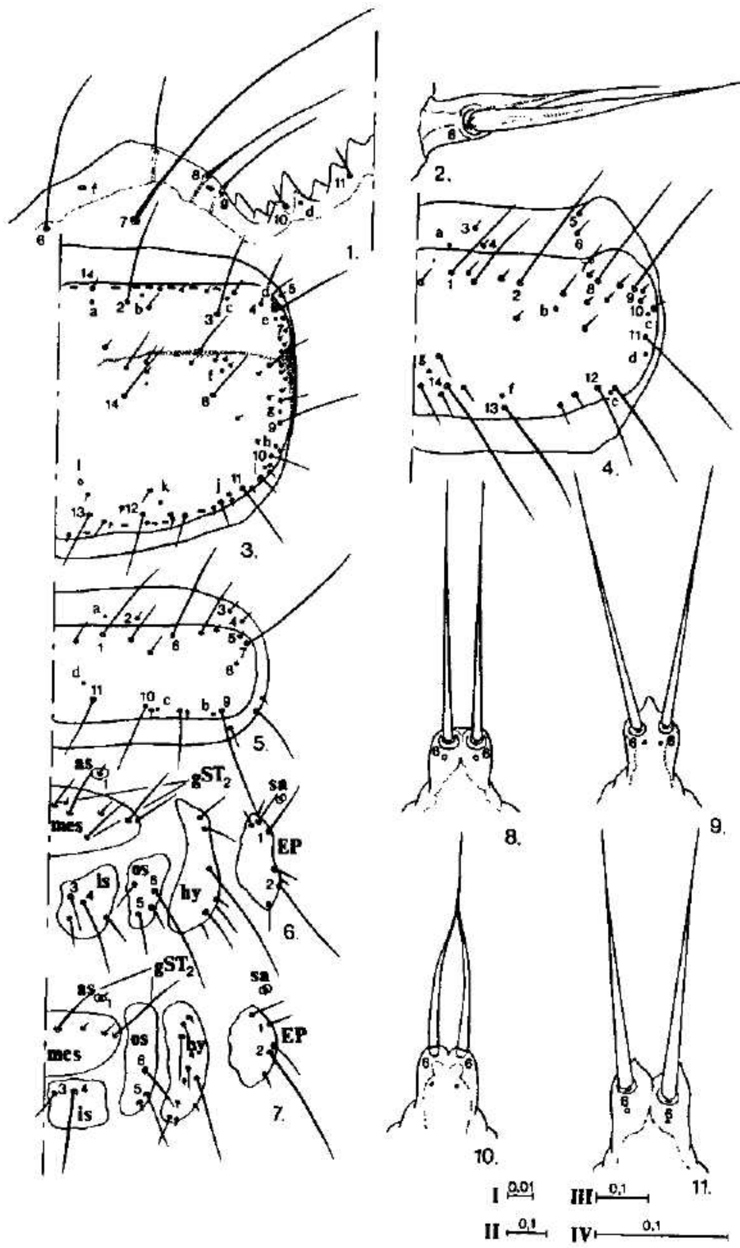
The larvae were examined at magnifications of 55.5×, 120×, 150× and 600× with the aid of a contrast microscope. For examination of the chaetotaxy 25 total preparations in the Faure-Berlese liquid were made. Measurements were made using an ocular micrometer of a contrast microscope at magnifications of 55.5–150×. The notation of primary setae and pores follows that of Bousquet & Goulet (1984), notation of secondary setae on the mandible and urogomphi follows that of Bousquet (1985), classification of sensillae follows that of Snodgrass (1935) and notation of setae-groups follows that of Makarov (1993).

Cluster analyses (method of bigeminal unweighted means) were used to estimate the reciprocal parentage of the species and subgenera. The power of resemblance was evaluated using the Jaccar-coefficient.

DESCRIPTION

Genus *Stenolophus* Stephens, 1828

Cephalic capsule transversal (W/L=1.23–1.50), slightly around by sides, with well developed microsculpture or lacking microsculpture. Nasale projected, with the larger central portion and two strong teeth on each side of it. Egg-bursters of first instar larvae consisting of 8–15 minute, equidistant teeth of different size (smaller ones at base of frontal sclerite) on eash side along frontal sutures. Coronal suture distinct, cervical groove present, extended dorsally near PA_5 and ventrally near PA_{15}, ocular groove absent. Adnasale apart from FR_8 and FR_9 with one additional seta on each side and one basiconical sensilla, located basal of FR_8 and FR_9 (Fig. 1). Sensilla FR_f basiconical. Mandibles massive, retinaculum large, located near base, cutting edges of mandibles and retinaculum smooth. Seta MN_a absent. Antennae not, or slightly longer than mandibles. Antennomeres I and II without or with additional setae, ventral side of antennomere II with one or two additional basiconical sensillae. Lacin ia slender, with strongly acuminate apex and with powerful seta MX_6, as long as seta MX_5 (Fig. 2); gMX with 25–44 setae, no unequal numbers of setae in gMX. Submentum subquadrate or distinctly longitudinal. Ligula with blunt or sharp apex, seta LA_4 absent. Labial palpomere I without additional setae. Thoracic tergites transversal (W/L of prothorax=1.55–2.0; W/L of meso- and metathorax=2.95–4.0), sclerotised, with clear borders (Figs 3–4). Numerous proprioreceptors along front and basal sides of prot horax. Femur with three to eight secondary spiniform setae on ventral side, trochanter with two or three secondary setae or asetose. Abdominal tergites distinctly transversal (W/L=3.0–4.0), poorly sclerotised, with or without microsculpture, without transversal keel separating praetergum from tergum, posterior borders indistinct (Fig. 5). Seta TE_{11} as long as seta TE_9. Secondary setae on thoracic and abdominal tergites very numerous, booth long and short. Sternites poorly sclerotised, with borders v ery indistinct (Figs 6–7). Urogomphi not less than 1.7 times longer than pygidium. Seta UR(present, single or as a group of setae.



Figs 1–11. Species of the genus *Stenolophus* Stephens– third instar larvae. 1 – left adnasale plate, dorsal view; 2 – lacinia, dorsal view; 3 – pronotum, dorsal view; 4 – mesonotum; 8–11 lingula, dorsal view. Explanations: as – anterior sternite, mes – median sternite, is – outer sternite, hy – hypopleurite, EP – epipeurite, sa – stigma. 1, 8 – *S.* (s. str.) *propinquus* A. Morawitz; 2, 10 – *S.* (*Astenolophus*) *fulvicornis* Bates; 3, 9 – *S.* (s. str.) *persicus* Mannerheim; 4 – *S.* (s. str.) *mixtus* (Herbst); 5, 11 – *S.* (*Egadroma*) *quiquepustulatus* (Wiedemann); 6 – *S.* (s. str.) *teutonus* (Schrank); 7 – *S.* (s. str.) *connotatus* Bates Scales: I – 2, 7–11; II – 3, 5–6; III – 4; IV – 1.

Subgenus *Stenolophus* s. str.

Head dark reddish-brown to yellowish-brown; thoracic tergites reddish-brown to pale yellowish-brown; abdominal tergites brownish-yellow to yellowish-white; urogomphi yellowish to white. Head with well developed microsculpture or practically lacking microsculpture. Nasale narrow, distinctly projected: distance between pores FR_d not more than 1.3 times longer than distance from pore FR_d to adnasale plate; height of median area 1.6–2.2 times smaller than distance between pores FR_d (Figs 12–17). Egg-bursters consisting of 8–15 minute teeth on each side along frontal sutures. Coronal suture long, as long as labial palpomere I. Antennomere I with 1–2, antennomere II with 3–5 additional setae (Figs 23–24) or without additional setae (Fig. 25); antennomere II distinctly longer than antennomere IV. Stipes slender (L/W=2.6–3.0), gMX with 25–44 setae. Submentum subquadrate (L/W=0.9–1.1) or distinctly longitudinal (L/W=1.30–1.36). Apex of ligula blunt (Fig. 8) or sharp (Fig. 9), setae LA_6 located dorsally. Abdominal tergites with well developed microsculpture or lacking microsculpture. Femur as long as tarsus and tibia combined (Fig. 20), with 3–8 secondary spiniform setae on ventral side, trochanter with 1–3 secondary setae or without it. Six to ten paires of long setae along anterior tergal borders, 8–12 paires of setae along posterior borders. Hypopleurite with 5–11 setae, median sternite with 3–10 pairs of setae, inner sternite with 2–6 and outer sternite with 3–5 setae. Urogomphi much shorter, n ot more than 1.9 times longer than pygidium. UR_a present as a single seta or as a group of setae.

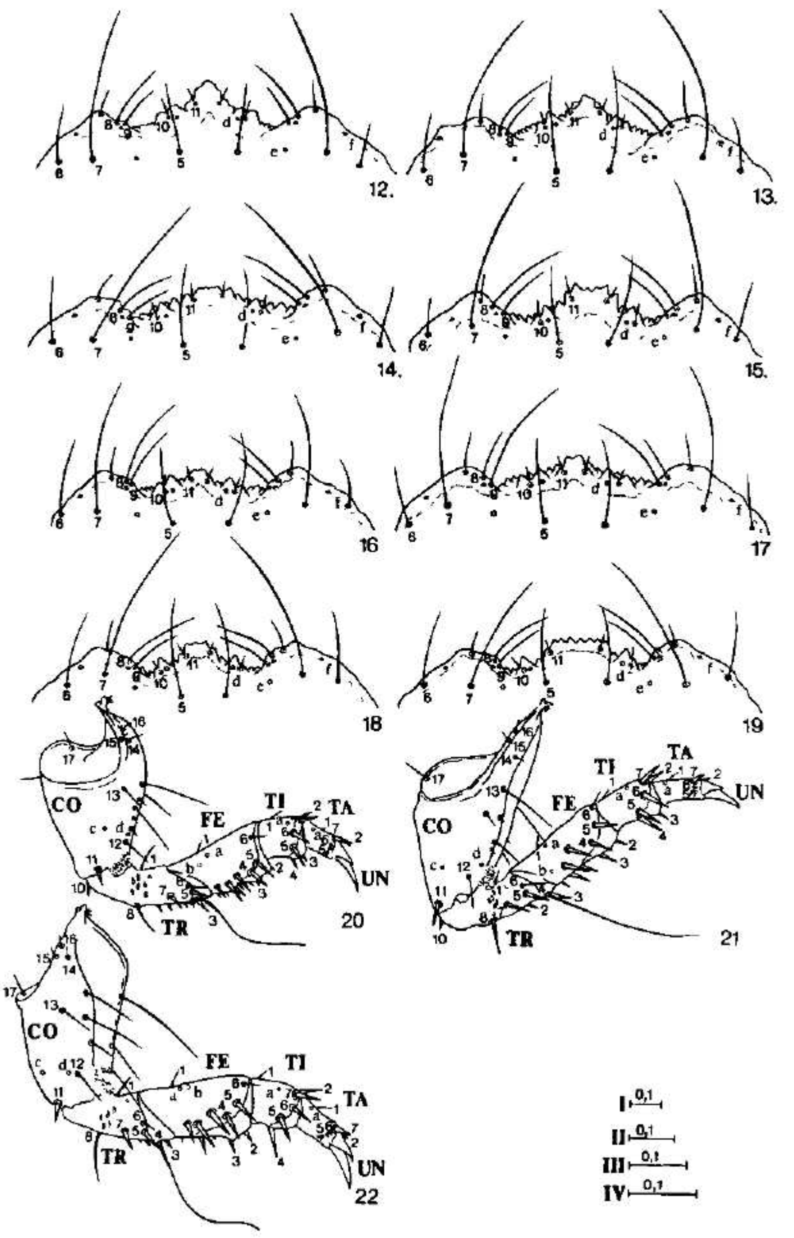
Stenolophus* (s. str.) *discophorus Fischer von Waldheim, 1823
(Figs 12, 23, 31, 39, 47, 57)

Head pale brown, thoracic tergites yellowish, abdominal tergites and urogomphi yellowish-white. Surface of head with rough isodiametric microsculpture, except for areas near setae FR_1–FR_2, FR_6–FR_7, PA_1 and PA_8, occiput distinctly wrinkled. Nasale with united group of teeth in medial area (Fig. 12). Retinaculum very wide (Fig. 28). Antennomere I with 1–2, antennomere II with 4–5 additional setae (Fig. 23). Stipes slender (L/W=3.4–3.6), with five setae on outer side, gMX with 36–39 setae (Fig. 31). Su bmentum distinctly longitudinal (L/W=1.30–1.31), with 25–27 setae on dorso-lateral surface, gLA5 with 2 setae, ligula with blunt apex (Fig. 39). Femur with 10 secondary spiniform setae ventrally, trochanter with 7 secondary setae. Hypopleurite with 10 setae, median sternite with 10 pairs of setae, inner sternite with 6 and outer sternite with 5 setae. gUR_a with 2 long setae. Pygidium slender (L/W=2.0–2.1), sternal side with 8 long setae.
AGE DIFFERENCES. In second-instar larva antennomere II with 2 additional setae, antennomere I without additional setae. Femur with 6 secondary spiniform setae on ventral side.

In first-instar larva head with very poor isodiametric microsculpture in basal area of frontal sclerite. Egg-bursters consisting of 13–15 minute teeth on each side (Fig. 47). Retinaculum moderately wide. Stipes more stocky (L/W=2.19–2.20), gMX with 30–31 setae.

Stenolophus* (s. str.) *connotatus Bates, 1873
(Figs 7, 13, 20, 24, 28, 32, 40, 48)

Head yellowish-brown, thoracic tergites paler than head, abdominal tergites much paler yellowish-brown, urogomphi yellowish-white. Head with well developed isodiametric microsculpture in the basal area of frontal sclerite, between setae $FR_{5\,4}$–FR_7, $FR_{5\,4}$–FR_3, FR_3–FR_2, PA_9–PA_8–PA_5, PA_{12}–PA_{15} and along posterior edge of cervical groove; occiput wrinkled. Thoracic and abdominal tergites with multipointed microsculpture. Nasale with united group of teeth in me



Figs 12–22 Species of the genus *Stenolophus* Stephens – third instar larvae 12–19 – anterior margin of frontale, dorsal view: 20–21 – fore leg, lateroanterior view Explanations UN – claws, TA – tarsus, TI – tibia, FE – femur, TR – trochanter, CO – coxa 12 – *S* (s str) *discophorus* Fischer von Waldheim, 13, 20 – *S* (s str) *connotatus* Bates, 14 – *S* (s str) *propinquus* A Morawitz; 15 – *S* (s str.) *persicus* Mannerheim; 16 – *S* (s str) *teutonus* (Schrank), 17 – *S* (s. str.) *mixtus* (Herbst), 18, 21 – *S* (*Astenolophus*) *fulvicornis* Bates; 19, 22 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann) Scales· I –20, II – 12, 16, 21–22; III – 13, 15, 18–19; IV – 14, 17.

dial area (Fig. 13). Retinaculum very wide (Fig. 28). Antennomere II with 3–4 additional setae (Fig. 24). Stipes slender (L/W=3.4), with 6 setae on outer side, gMX with 41–44 setae (Fig. 32). Submentum distinctly longitudinal (L/W=1.36), with 39–40 setae on dorso-lateral surface, gLA_5 with 2 setae, ligula with sharp apex (Fig. 40). Femur with 8 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. Hypopleurite with 8 setae, median sternit with 4 pairs of setae, inner sternite with 2 and outer sternite with 3 setae, latt er in form and size of hypopleurite (Fig. 7). Seta UR(single, long. Pygidium stocky (L/W=2.0–2.1), sternite with 8 setae.
AGE DIFFERENCES. In first-instar larva egg-bursters consisting of 9 minute teeth on each side along frontal sutures (Fig. 48). Retinaculum moderately wide.

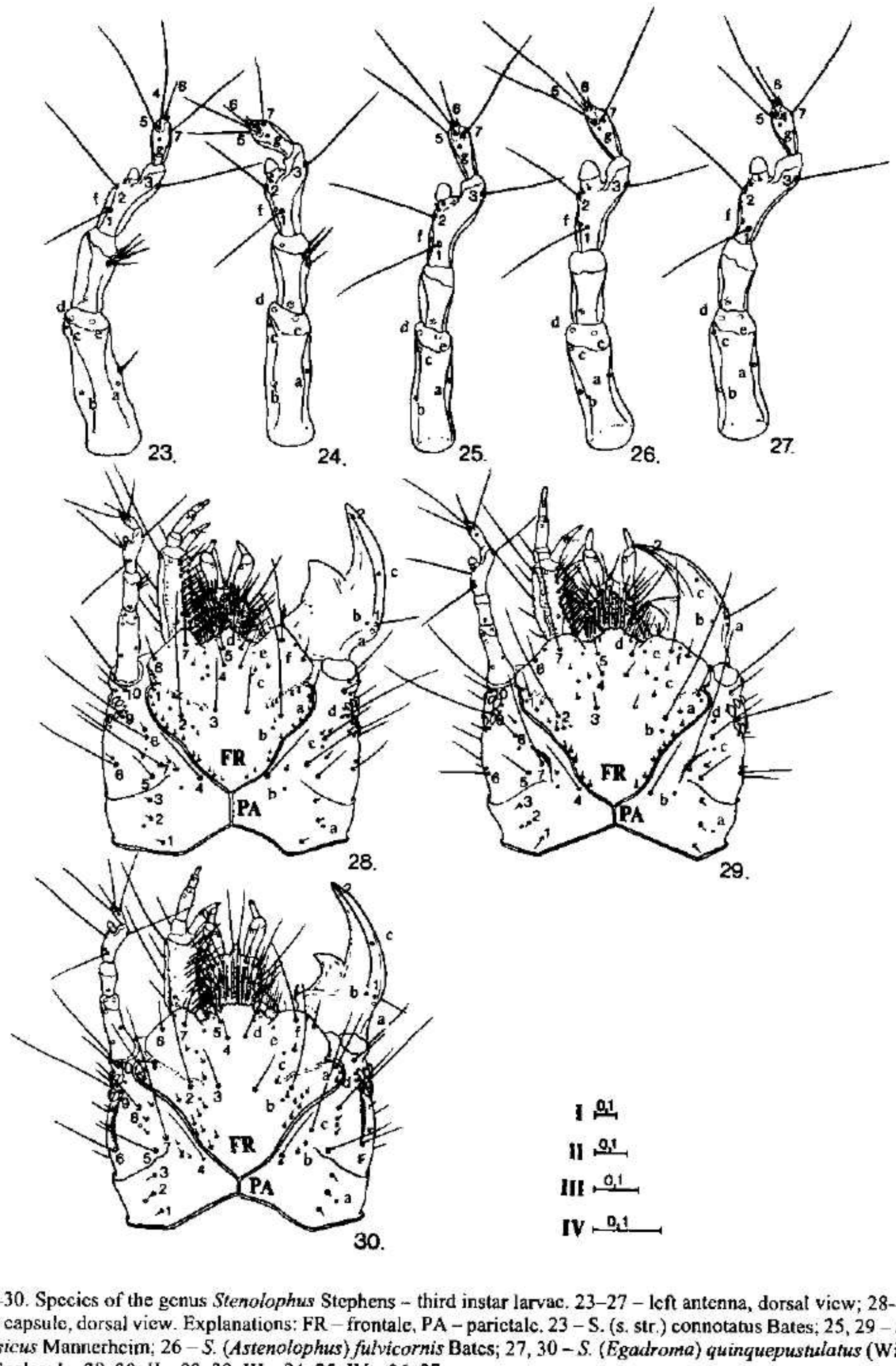
Stenolophus (s. str.) *propinquus* A. Morawitz, 1862
(Figs 1, 8, 14, 33, 41, 49)

Head and prothorax reddish-brown, meso- and metathorax pale yellowish-brown, abdominal tergites paler yellowish-brown or brownish-yellow, urogomphi white. Head with well developed microsculpture: isodiametric on frontal sclerite, in area of coronal suture, near setae PA7, between setae PA_9–PA_8–PA_6, PA_{11}–PA_{14}–PA_{15} and finely wrinkled near setae PA_{17}–PA_{18}. Nasale with united group of teeth in medial area (Fig. 14). Stipes stocky (L/W=2.6), with 4 setae on outer side, gMX with 26–30 setae (Fig. 33). Submentum subquadrate (L/W=1.05), with 16–17 setae on dorso-lateral surface, ligula with blunt apex (Fig. 41). Femur with 5 secondary spiniform setae on ventral side, trochanter without secondary setae, Hypopleurite with 6 setae, median sternite with 6 pairs of setae, inner sternite with 4 and outer sternite with 5 setae. gUR_a with 2 long setae. Pygidium stocky (L/W=1.60–1.65), sternite with 5 long setae.
AGE DIFFERENCES. In first-instar larva egg-bursters consisting of 7–8 minute teeth on each side of frontal suture, front tooth slightly distant from frontal suture (Fig. 49).

Stenolophus (s. str.) *persicus* Mannerheim, 1844
(Figs 3, 9, 15, 25, 29, 34, 42, 50, 56)

Head dark reddish-brown, thoracic tergites pale reddish-brown, abdominal tergites brownish-yellow, urogomphi yellowish. Head with fine isodiametric microsculpture near setae FR_3 and PA_6, and also between setae PA_{1-3}–PA_4; posterior edge of cervical groov a finely wrinkled. Thoracic and abdominal tergites with distinct multipointed microsculpture. Nasale incised at middle, so teeth divided into two groups (Fig. 15). Head with furrow near seta PA_7 (Fig. 29). Stipes slender (L/W=3.36–3.38), with 5 setae on outer side, gMX with 33–35 setae (Fig. 34). Submentum subquadrate (L/W=0.90–0.92), with 13–15 setae on dorso-lateral surface, ligula with sharp apex (Fig. 42). Pores PRb and PRc located near setae PR_2 and PR_3, respectively. Femur with 5–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 3 pairs of setae, inner and outer sternites with 5 setae each. gUR_a with 2 long setae. Pygidium slender (L/W=2.0–2.1), sternite with 4 long setae.
AGE DIFFERENCES. In second-instar larva head with fine microsculpture near setae FR_2, FR_3 and PA_4. Stipes stocky (L/W=2.80–2.83), gMX with 30–32 setae. Submentum with 10–11 setae on dorso-lateral surface. Pores PR_b and PR_c located between setae PR_2–PR_3 and PR_3–PR_4, respectively. Trochanter with 1 secondary spiniform seta on ventral side. Inner and outer sternites with 4 setae each.

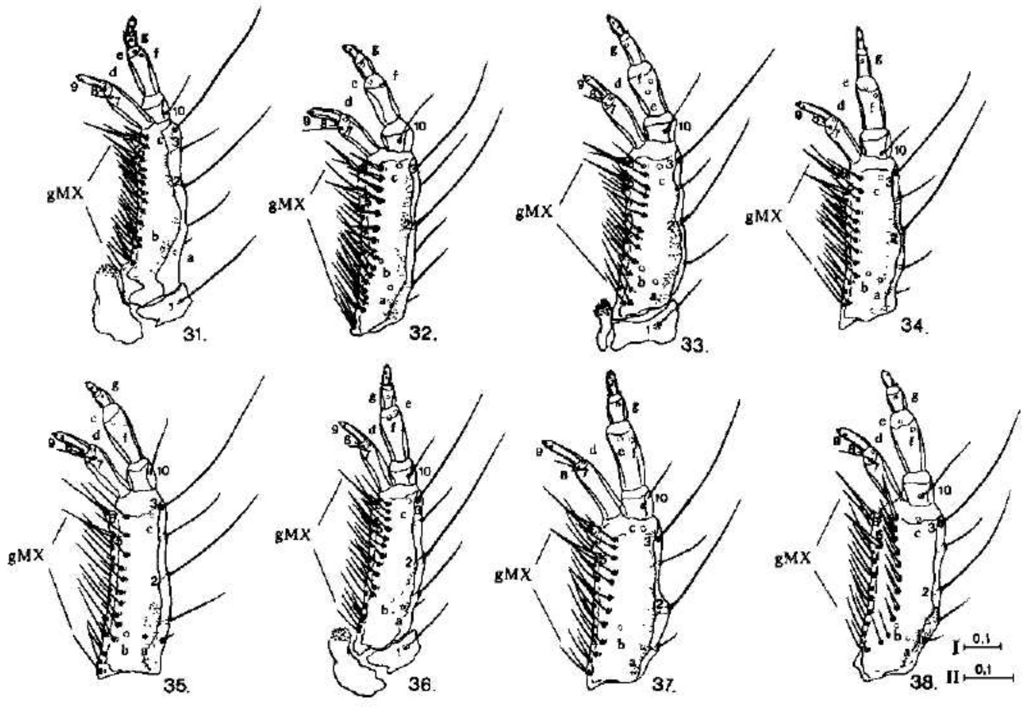
In first-instar larva head with very poor isodiametric microsculpture in basal area of frontal sclerite and between setae PA_4–PA_7. Egg-bursters consisting of 12–14 minute teeth on each side along frontal sutures (Fig. 50). Stipes more stocky (L/W=2.30–2.34), gMX with 28–30 setae.



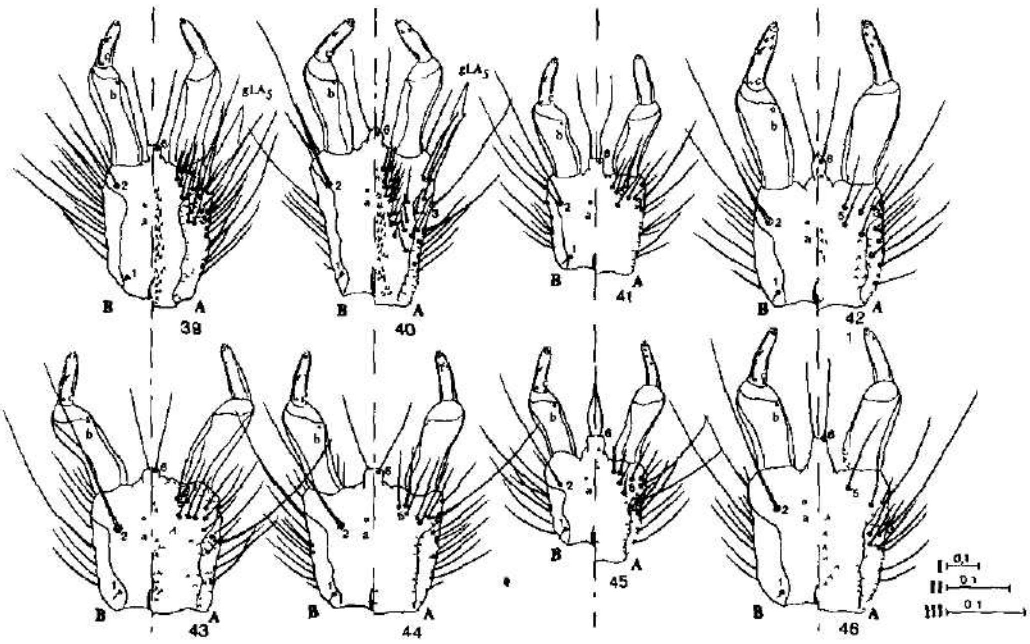
Figs 23–30. Species of the genus *Stenolophus* Stephens – third instar larvae. 23–27 – left antenna, dorsal view; 28–30 – cephalic capsule, dorsal view. Explanations: FR – frontale, PA – parietale. 23 – S. (s. str.) connotatus Bates; 25, 29 – *S.* (s. str.) *persicus* Mannerheim; 26 – *S.* (*Astenolophus*) *fulvicornis* Bates; 27, 30 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann). Scales: I – 28, 30; II – 23, 29; III – 24–25; IV – 26–27.

Stenolophus* (s. str.) *teutonus (Schrank, 1781)
(Figs 6, 16, 35, 43)

Head chocolate brown, thoracic tergites pale brown, abdominal tergites yellowish, urogomphi wellowish-white. Head with rough isodiametric microsculpture in central area of frontal sclerite, along frontal sutures up to seta PA_7 and between setae PA_{12}–PA_{17}–PA_{16}. Nasale with united group of teeth in medial area (Fig. 16). Stipes slender (L/W=3.0), with 5 setae on outer side, gMX with 28–30 setae (Fig. 35). Maxillary palpomere II 3.5–4.0 times longer than maxillary palpomere IV. Submentum subquadrate (L /W=0.98), with 17 setae dorso-laterally, ligula with blunt apex (Fig. 43). Femur with 7 secondary spiniform setae ventrally, trochanter with 3 secondary setae. Hypopleurite with 7 setae, median sternite with 7 pairs of setae, inner and outer sternites with 4 setae each. gUR_4 with 2 long and 1 short setae. Pygidium slender (L/W=2.5), sternite with 5 long setae.



Figs 31–38. Species of the genus *Stenolophus* Stephens – third instar larvae. Right maxilla, dorsal view. 31 – *S.* (s. str.) *discophorus* Fischer von Waldheim; 32 – *S.* (s. str.) *connotatus* Bates; 33 – *S.* (s. str.) *propinquus* A. Morawitz; 34 – *S.* (s. str.) *persicus* Mannerheim; 35 – *S.* (s. str.) *teutonus* (Schrank); 36 – *S.* (s. str.) *mixtus* (Herbst); 37 – *S.* (*Astenolophus*) *fulvicornis* Bates; 38 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann). Scales: I – 31; II – 32–38.

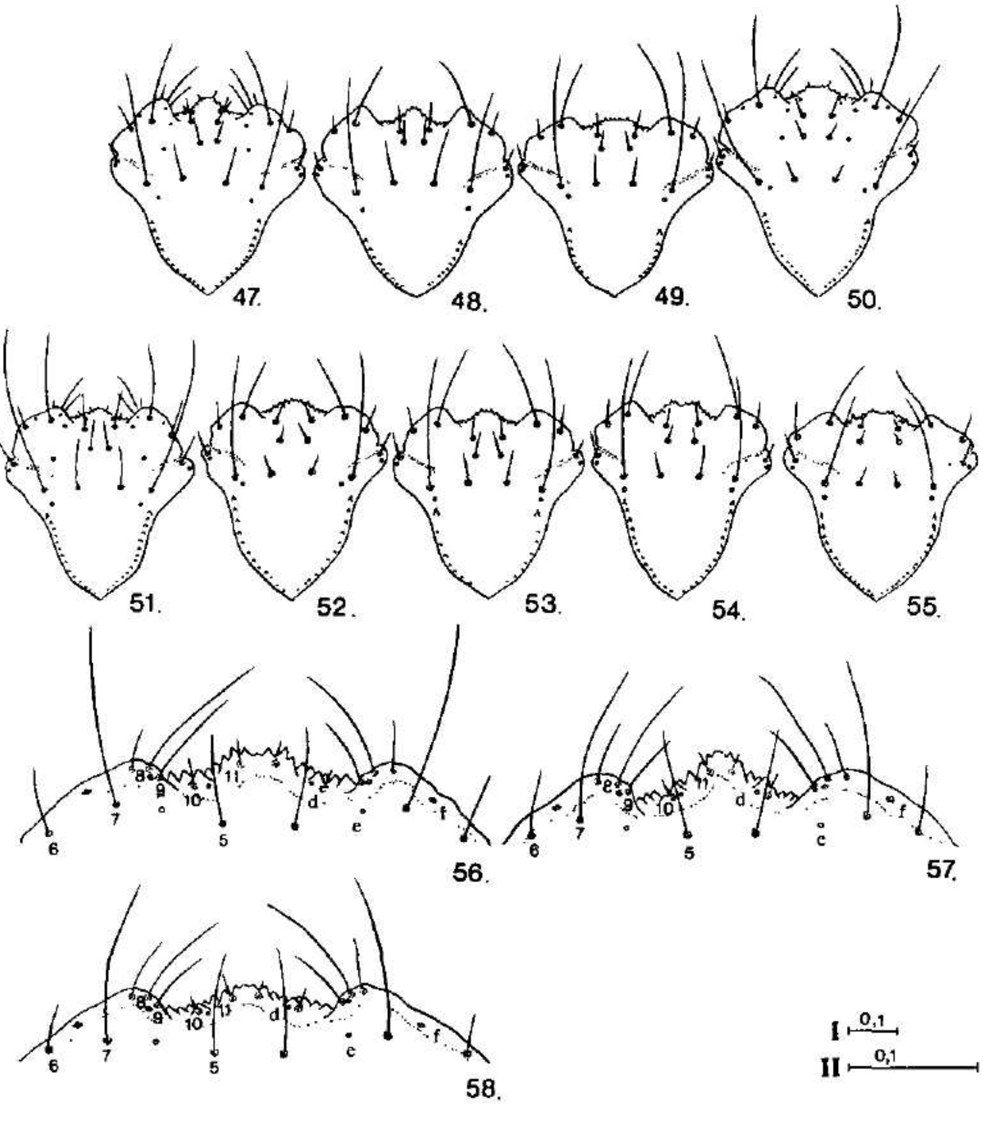


Figs 39–46. Species of the genus *Stenolophus* Stephens – third instar larvae. Labium (A – dorsal view, B – ventral view). 39 – *S.* (s. str.) *discophorus* Fischer von Waldheim, 40 – *S.* (s. str.) *connotatus* Bates, 41 – *S.* (s. str.) *propinquus* A. Morawitz, 42 – *S.* (s. str.) *persicus* Mannerheim, 43 – *S.* (s. str.) *teutonus* (Schrank), 44 – *S.* (s. str.) *mixtus* (Herbst), 45 – *S.* (*Astenolophus*) *fulvicornis* Bates, 46 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann). Scales: I – 42, II – 39–41, 43, 45–46, III – 44

Stenolophus* (s. str.) *mixtus (Herbst, 1784)
(Figs 4, 17, 36, 44, 51, 58)

Head pale brown, thoracic tergites pale yellowish-brown, abdominal tergites yellowish-white, urogomphi white. Head with fine isodiametric microsculpture between setae FR_3–FR_4, PA_3–PA_4, $PA_{2,3}$–PA_4 and near seta PA_6, occiput and area near setae PA_4, PA_3, PA_4 and PA_5 finely wrinkled. Nasale with united group of teeth in medial area (Fig. 17). Stipes slender (L/W=3.0), with 5 setae on outer side, gMX with 33–37 setae (Fig. 36). Submentum subquadrate (L/W=0.95), with 21–23 setae on dorso-lateral surface, ligula with blunt apex (Fig. 44). Femur with 5–6 secondary spiniform setae ventrally, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 4 pairs of setae, inner and outer sternites with 3 setae each. Seta UR_a single, long. Pygidium slender (L/W=1.90–1.93), sternite with 4 long setae.

AGE DIFERENCES. In second-instar larva microsculpture of head developed poorly. Stipes stocky (L/W=2.33–2.35), gMX with 29–32 setae. Submentum with 16 setae on dorso-lateral surface. Trochanter with 1 secondary spiniform seta ventrally.



Figs 47–58. Species of the genus *Stenolophus* Stephens – first instar larvae. 47–55 – frontal sclerite, dorsal view; 56–58 – anterior margin of frontale, dorsal view. 47, 57 – *S.* (s. str.) *discophorus* Fischer von Waldheim; 48 – *S.* (s. str.) *connotatus* Bates (after Habu 1973); 49 – *S.* (s. str.) *propinquus* A. Morawitz (after Habu 1973); 50, 56 – *S.* (s. str.) *persicus* Mannerheim; 51, 58 – *S.* (s. str.) *mixtus* (Herbst); 52 – *S.* (s. str.) *iridicolor* Redtenbacher (after Habu 1973); 53 – *S.* (*Astenolophus*) *fulvicornis* Bates (after Habu 1973); 54 – *S.* (*Egadroma*) *difficilis* (Hope) (after Habu 1973); 55 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann) (after Habu 1973). Scales: I – 47–55; II – 56–58.

In first-instar larva head with fine isodiametric microsculpture in basal area of frontal sclerite and near seta PA_7. Egg-bursters consist of 12–15 minute teeth on each side along frontal sutures (Fig. 51). Stipes more stocky (L/W=2.2), gMX with 25–27 setae.

Subgenus *Astenolophus* Habu, 1973

Stenolophus (Astenolophus) fulvicornis Bates, 1873
(Figs 2, 10, 18, 21, 26, 37, 45, 53)

Head pale yellowish-brown, slightly reddish near apical margin and at central area. Pro-, meso- and metanotum pale brownish-yellow. Abdominal tergites yellowish. Head with poorly developed microsculpture, isodiametric near setae FR_{4-5}, PA_7 and wrinkled in area of coronal suture. Nasale relatively wide, projected: distance between pores FR_d not less than 1.5 times longer than distance from pore FR_d to adnasal plate; height of median area 2.5 times lower than distance between pores FR_d (Fig. 18). Egg-bursters consist of 8 minute teeth on each side along frontal suture, front tooth distant from seta FR_2 (F_2 following Habu 1973) on 1/4 seta length (Fig. 53). Coronal suture short, as long as labial palpomere II. Antennomeres I and II without additional setae; antennomere II distinctly longer than antennomere IV (Fig. 26). Stipes stocky (L/W=2.0–2.3), with lateral projection near seta MX_2, gMX with 25–28 setae (Fig. 37). Submentum subquadrate (L/W=1.1), ligula with blunt apex, setae LA_6 located apically (Figs 10, 45). Abdominal tergites without microsculpture. Femur distinctly shorter than tarsus and tibia combined, the former with 5 secondary spiniform setae on ventral side, trochanter without secondary setae (Fig. 21). Eight pairs of long setae along both anterior and posterior tergal borders. Hypopleurite with 5 setae, median sternite with 4 pairs of setae, inner sternite with 3 and outer sternite with 6 setae. Urogomphi relatively long, not less than 2.0 times longer than pygidium. gUR_a w ith 2 long setae.

Subgenus *Egadroma* Motschulsky, 1855

Head yellowish or pale reddish-brown. Pronotum yellowish or pale yellowish-brown, sometimes slightly reddish; meso- and metanotum paler. Tergites pale brownish-yellow or very pale yellowish-brown. Head with well developed microsculpture. Nasale wide, poorly projected: distance between pores FRd not less than 2.2 times longer than distance from pore FR_d to adnasale plate; height of median area 2.5–3.0 times lower than distance between pores FR_d (Fig. 19). Egg-bursters consist of 14–15 minute teeth on each side along frontal sutures. Coronal suture short, as long as labial palpomere II. Antennomeres I and II without additional setae; antennomere II as long as antennomere IV (Fig. 27). Stipes slender (L/W=2.6–3.0), gMX with 25–27 setae. Submentum subquadrate (L/W=1.04), ligula with blunt apex, seta LA6 located dorsally (Fig. 11). Abdominal tergites with developed microsculpture. Femur distinctly longer than tarsus and tibia combined, the former with 4–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae or without it (Fig. 22). Along anterior tergal borders 3–7 pairs of long setae, along posterior tergal borders 4–5 pairs. Hypopleurite with 5 setae, median sternite with 5 pairs of setae, both inner and outer sternites with 3 setae each. Urogomphi very long, not less than 2.3 times longer than pygidium. gUR_a with 2 long setae.

Stenolophus (Egadroma) quinquepustulatus (Wiedemann, 1823)

Head and prothorax yellowish-brown, meso- and metathorax paler, abdominal tergites brownish-yellow, urogomphi white. All head surface with isodiametric microsculpture which is finer near setae FR_1–FR_2, PA_6, PA_7 and PA_1–PA_3. Thoracic and abdominal tergites with fine isodiametric microsculpture. Urogomphi distinctly microsculptured. Nasale with wide and even notched median area (Fig. 19). Head with a furrow between setae PA_9 and PA_6 (O_2–L_1 following Habu 1973) (Fig. 30). Stipes stocky (L/W=2.6), with 5 setae on outer side, gMX with 25–27 setae (Fig. 38). Submentum subquadrate (L/W=1.04), with 14 setae on dorso-lateral surface, ligula with blunt apex (Fig. 46). Femur with 6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 5 pairs of setae, inner and outer sternites with 3 setae each. gUR_a with 2 long setae. Pygidium slender (L/W=2.3–2.4), sternite with 3 long setae.

AGE DIFFERENCES. First-instar larva paler. Nasale less projected. Egg-bursters consisting of 14–15 minute teeth on each side along frontal sutures (Fig. 55).

Key to subgenera and species of first-instar larvae of *Stenolophus*

1 (2) Coronal suture short. Frontal sclerite with no less than 14 teeth in each egg-burster. ..... (15)

2 (1) Coronal suture long. Frontal sclerite with 8–15 teeth in each egg-burster. ..... (3)

3 (4) Nasale incised at middle, so teeth divided into two groups (Fig. 56). Frontal sclerite with 12–14 teeth in each egg-burster (Fig. 50). Stipes slender (L/W=2.30–2.34), gMX with 30–32 setae, maxillary palpomere III as long as maxillary palpomere IV. Submentum subquadrate (L/W=0.94), ligula with sharp apex. WH=0.61–0.71 (0.65) mm ..... *S.* (s. str.) *persicus*

4 (3) Nasale with united group of teeth in median area (Figs 57–58) ..... (5)

5 (6) All teeth of egg bursters placed equidistant from frontal sutures (Figs 47–48, 51–52). ..... (7)

6 (5) Front tooth of egg-bursters slightly but distinctly distant from frontal sutures (Figs 49, 53) ..... (13)

7 (8) Frontal sclerite with no more than 9 teeth in each egg-burster (Fig. 48). WH=0.69–0.74 (0.71) (after Habu 1973) ..... *S.* (s. str.) *connotatus*

8 (7) Frontal sclerite with no less than 10 teeth in each egg-burster ..... (9)

9 (10) Frontal sclerite with 11–12 teeth in each egg-burster (Fig. 52). WH=0.50–0.53 (0.51) mm (after Habu 1973) ..... *S.* (s. str.) *iridicolor*

10 (9) Frontal sclerite with more than 12 teeth in each egg-burster. ..... (11)

11 (12) Nasale as on Fig. 58. Maxillary palpomere III as long as maxillary palpomere IV. Galeomere I 1.5 times longer than galeomere II. Antennomere I distinctly longer than antennomere III. Tarsus as long as tibia. WH=0.56–0.68 (0.62) mm. ..... *S.* (s. str.) *mixtus*

12 (11) Nasale as on Fig. 57. Maxillary palpomere III distinctly longer than maxillary palpomere IV. Galeomere I only 1.2 times longer than galeomere II. Antennomere I as long as antennomere III. Tarsus distinctly shorter than tibia. *WH=0.68–0.74 (0.71) mm* ..... *S.* (*s. str.*) *discophorus*

13 (14) Frontal sclerite with 7–8 teeth in each egg-burster, front tooth distant from seta FR_2 on 1/2 of seta length (Fig. 49). WH=0.52–0.55 (0.53) mm (after Habu 1973). ..... *S.* (s. str.) *propinquus*

14 (13) Frontal sclerite with 8 teeth in each egg-burster, front tooth distant from seta FR_2 on 1/4 of seta length (Fig. 53). WH=0.47–0.52 (0.50) mm (after Habu 1973). ..... *S.* (*Astenolophus*) *fulvicornis*

15 (16) Nasale incised at middle, so teeth divided into two groups (Fig. 54). Frontal sclerite with 14 teeth in each egg-burster. WH=0.50–0.53 (0.51) mm (after Habu 1973) ..... *S.* (*Egadroma*) *difficilis*

16 (15) Nasale with united group of teeth in median area (Fig. 55). Frontal sclerite with 14–15 teeth in each egg-burster. WH=0.52–0.56 (0.53) mm (after Habu 1973). ..... *S.* (*E.*) *quinquepustulatus*

Key to subgenera and species of second/third-instar larvae of *Stenolophus*

1 (2) Nasale narrow, distinctly projected: distance between pores FRd not more than 1.3 times longer than distance from pore FR_d to adnasale plate, height of median area 1.6–2.2 times lower than distance between pores FR_d (Figs 12–17). Coronal suture long, as long as labial palpomere I. Urogomphi relatively shorter, no more than 1.9 times longer than pygidium ..... subgenus *Stenolophus*

2 (1) Nasale wide, poorly projected: distance between pores FRd not less than 1.5 times longer than distance from pore FR_d to adnasale plate; height of median area 2.5–3.0 times lower than distance between pores FR_d (Figs 18–19). Coronal suture short, as long as labial palpomere II. Urogomphi longer, no less than 2.0 times longer than pygidium. .... (15)

3 (4) Antennomere II with 3–5 additional setae (Figs 23–24). Submentum distinctly longitudinal, with more than 25 setae on dorso-lateral surface. gLA_5 with 2 setae. .... (5)

4 (3) Antennomere II without additional setae (Fig. 25). Submentum distinctly longitudinal, with less than 23 setae on dorso-lateral surface. Seta LA_5 single .... (7)

5 (6) Antennomere I with 1–2 additional setae (Fig.23). Stipes with 5 setae on outer side, gMX with 36–39 setae. Submentum with 25–27 setae on dorso-lateral surface, ligula with blunt apex. Femur with 10 secondary spiniform setae on ventral side, trochanter with 7 secondary setae. WH L_2=0.96–1.11 (1.04) mm, L_3= 1.47–1.55 (1.51) mm .... *S.* (s. str.) *discophorus*

6 (5) Antennomere I without additional setae (Fig. 24). Stipes with 6 setae on outer side, gMX with 41–44 setae. Submentum with 39–40 setae on dorso-lateral surface, ligula with sharp apex. Femur with 8 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. WH L_2=0.9–1.01 (0.97) mm, L_3= 1.22–1.45 (1.35) mm .... *S.* (s. str.) *connotatus*

7 (8) Head with well developed microsculpture. Stipes stocky (L/W=no more than 2.6). Antennomere I no more than 1.6 times longer than antennomere IV, antennomere II with 2 additional basiconical sensillae. WH L_2=0.66–0.70 (0.68) mm, L_3=0.83–0.93 (0.87) mm. .... *S.* (s. str.) *propinquus*

8 (7) Head with poorly developed microsculpture. Stipes slender (L/W=no less than 3.0). Antennomere I no less than 2.0 times longer than antennomere IV, antenomere II with only 1 additional basiconical sensilla .... (9)

9 (12) Head and thoracic tergites chocolate brown, well sclerotised. Maxillary palpomere III distinctly longer than maxillary palpomere IV. Galeomere I shorter, no more than 1.5 times longer than galeomere II. Labial palpomere I shorter, no more than 1.7 times longer than labial palpomere II. gUR_α with 2 long setae .... (10)

10 (11) Cephalic capsule wider (W/L=1.40–1.44). Nasale incised at middle, so teeth divided into two groups (Fig. 15). Seta PA_{16} as long as setae PA_{11} and PA_{12}. Head with furrow near seta PA_7 (Fig 29). Maxillary palpomere II shorter, no more than 2.5 times longer than maxillary palpomere IV. Submentum with 13–15 setae on dorso-lateral surface, ligula with sharp apex (Fig. 9). Along posterior tergal borders 16 pairs of setae. Hypopleurite with 5 setae, median sternite with 3 pairs of setae. Femur with 5 secondary spiniform setae on ventral side, trochanter with 2 additional setae. gUR_α with 2 long setae. WH L_3=0.86–0.88 (0.87) mm, L_3=1.05 mm .... *S.* (s. str.) *persicus*

11 (10) Cephalic capsule less wide (W/L=1.30). Nasale with united group of teeth in median area (Fig. 16). Setae PA_{16} distinctly shorter than setae PA_{11} and PA_{12}. Head without furrow near seta PA_7. Maxillary palpomere II longer, no less than 3.5 times longer than maxillary palpomere IV. Submentum with 17–19 setae on dorso-lateral surface,

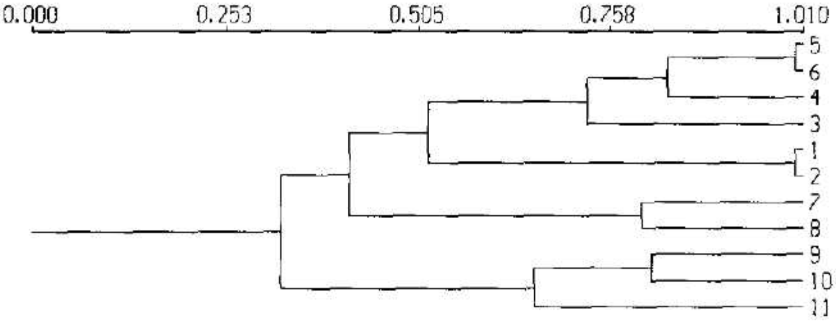


Fig. 59. Hypothetical phylogeny of the Holarctic species of the genus *Stenolophus* Stephens according to the larval characters. 1 – *Stenolophus* (s. str.) *discophorus* Fischer von Waldheim, 2 – *S.* (s. str.) *connotatus* Bates, 3 – *S.* (s. str.) *propinquus* A. Morawitz, 4 – *S.* (s. str.) *persicus* Mannerheim., 5 – *S.* (s. str.) *teutonus* (Schrank), 6 – *S.* (s. str.) *mixtus* (Herbst), 7 – *S.* (*Astenolophus*) *fulvicornis* Bates, 8 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann), 9 – *S.* (*Agonoderus*) *lineola* (Fabricius), 10 – *S.* (*Agonoderus*) *pallipes* (Fabricius), 11 – *S.* (s. str.) sp.

ligula with blunt apex (Fig. 8). Along posterior tergal borders 8 pairs of long setae Hypopleurite with 7 setae, median sternite with 7 paires of setae. Femur with 7 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. gUR_{α} with 2 long and 1 short setae. WH L_3=1 13 mm .... *S.* (s. str) *teutonus*

12 (9) Head and thoracic tergites yellowish-brown, poorly sclerotised. Maxillary palpomere III as long as maxillary palpomere IV Galeomere I longer, no less than 1 7 times longer than galeomere II Labial palpomere I longer, no less *than 1.8 times longer than labial palpomere II Seta UR_{α} single, long* ... ... (13)

13(14) Cephalic capsule narrower (W/L=1 20–1 23). Antennomere I 3.0 times longer than antennomere IV Along anterior tergal border 9, along posterior tergal border 12 pairs of long setae Femur with 5–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. WH L_2=0.74–0.76 (0 75) mm, L_3=0 87 mm. ....*S* (s. str.) *mixtus*

14 (13) Cephalic capsule wider (W/L=1 30–1 32) Antennomere I 2.5 times longer than antennomere IV. Along anterior tergal border 8, along posterior tergal border 6 pairs of long setae Femur with 3 secondary spiniform setae on ventral side, trochanter without secondary setae. WH L_2=0.68–0 72 (0.70) mm, L_3=0.91–1 00 (0 95) mm (after Habu 1973) ... ... *S* (s str.) *iridicolor*

15 (16) *Head with poorly developed microsculpture Antennomere II distinctly longer than antennomere IV. Stipes stocky* (L/W no more than 2.0–2.3), ligula with apically located setae LA_6 (Fig 10) Femur distinctly shorter than tarsus and tibia combined (Fig. 21) Urogomphi shorter, no more than 2.0 times longer than pygidium. WH L_2=0 60–0 64 (0 62) mm, L_3=0.77–0 84 (0 80) mm. .... subgenus *Astenolophus*, *S* (*A*) *fulvicornis*

16 (15) Head witl well developed microsculpture. Antennomere II as long as antennomere IV. Stipes slender (L/W no less than 2.6–3.0), ligula with dorsally located setae LA_6 (Fig. 11) Femur distinctly longer than tarsus and tibia combined (Fig. 22) Urogomphi longer, no less than 2.3 times longer than pygidium ... ..subgenus *Egadroma* (17)

17 (18) Cephalic capsule wider (W/L=1 40–1 42) Nasale not incides at middle (Fig 19). Head with furrow between setae PA_8 and PA_6 (Fig. 30). Along anterior tergal border 6 pairs, along posterior border 4 pairs of long setae Femur with 6 secondary spiniform setae, trochanter eith 2 secondary setae. WH L_2=0 68–0 77 (0 73) mm, L_3= 0.95–1 05 (1 00) mm. .... *S.* (*E.*) *quinquepustulatus*

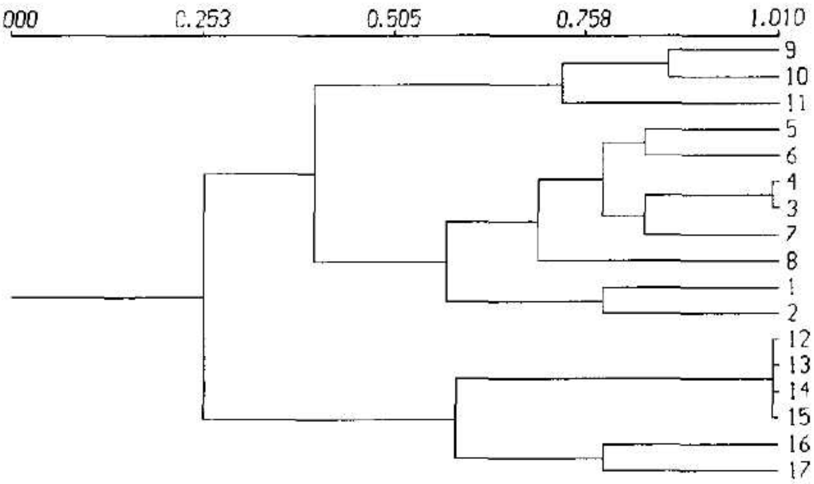


Fig 60. Hypothetical phylogeny of the Holarctic species of the subtribe Stenolophina according to the larval characters 1 – *Stenolophus* (s. str.) *discophorus* Fischer von Waldheim, 2 – *S* (s. str) *connotatus* Bates, 3 – *S* (s str.) *propinquus* A. Morawitz, 4 – *S.* (s. str) *persicus* Mannerheim , 5 – *S* (s. str) *teutonus* (Schrank), 6 – *S* (s str.) *mixtus* (Herbst), 7 – *S* (*Astenolophus*) *fulvicornis* Bates, 8 – *S.* (*Egadroma*) *quinquepustulatus* (Wiedemann), 9 – *S.* (*Agonoderus*) *lineola* (Fabricius), 10 – *S* (*Agonoderus*) *pallipes* (Fabricius), 11 – *S.* (s. str.) sp , 12 – *Dicheirotrichus* (s. str.) *gustavi* Crotch, 13 – *D* (s. str) *ustulatus* Dejean, 14 – *D* (s. str.) *desertus* Motschulsky, 15 – *D.* (s. str.) *abdominalis* Motschulsky, 16 – *D.* (*Trichocellus*) *alticola* Bates, 17 – *Bradycellus* (*Tachycellus*) *glabratus* Reitter.

18 (17) Cephalic capsule narrower (W/L=1.30–1.32). Nasale incised at middle, so teeth divided into two groups Head lacking furrow between setae PA_9 and PA_6. Along anterior tergal border 3 pairs, along posterior border 5 pairs of long setae. Femur with 4 secondary spiniform setae on ventral side, trochanter without secondary setae. WH L_2=0 68–0 70 (0.69) mm, L_3=0 81–1.01 (0.92) mm (after Habu 1973) .... *S.* (*E.*) *difficilis*

DISCUSSION

The relationships of the Stenolophina subtribe taxa studied are presented in Figs 59–60. There are three distinct species-complexes in the genus *Stenolophus* (Fig. 59). The first complex includes the Nearctic species (the value of Jaccar-coefficient (JC) in bifurcation area=0.325), the second complex includes species of the subgenera *Astenolophus* and *Egadroma* (JC=0.430) and third one includes the Palaearctic species of the nominotypical subgenus. *Stenolophus discophorus* and *S. connotatus* in the nominotypical subgenus are characterized as the most isolated species (JC=0.525). The comparision of the Palaearctic species of the genus *Stenolophus* with the Nearctic species and with the species of the genus *Dicheirotrichus* Jacquelin du Val, 1857 (following Kataev, in Kryzhanovskij et al. 1995) shows similar results (Fig. 60). In addition, *S. discophorus* and *S. connotatus* are isolated from the other Palaearctic species to the same degree as the species of the subgenera *Astenolophus* and *Egadroma* (JC=0.560). The larvae of *S. discophorus* and *S connotatus* display some characters of the larvae of the genus *Harpalus* Latreille, 1802. These characters, noted for the first time, are: well developed microsculpture on the head; wide, robust retinaculum; additional setae on the antennomeres I and II; longitudinal submentum, seta LA_5 presented as a group of setae; numerous secondary setae on dorso-lateral surface of submentum, in gMX and on ventral side of femur and trochanter. These species may represent a separate species-group, or even subgenus.

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Nicrophorus mexicanus (Coleoptera: Silphidae: Nicrophorinae): larval morphology and phylogenetic considerations on the *N. investigator* group

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Abstract. The authors describe and illustrate in detail the three larval stages of *Nicrophorus mexicanus* Matthews, 1888 (Coleoptera: Silphidae: Nicrophorinae), a common mexican and central-american carrion beetle. A study of the taxonomic value of larval characters, as well as the morpho-anatomical characters of adults, enables the authors to discuss the phylogenetic relationships among the species of the *N. investigator* group, which includes *N. mexicanus*. The species seems to be closely related to *N. investigator* Zetterstedt, 1824 and *N. nigrita* Mannerheim, 1843, while the remaining two species classified in the group (*N. hybridus* Hatch & Angell, 1925, and *N. tomentosus* Weber, 1801) appear to be more primitive. Results partly confirm phylogenetic hypotheses proposed by other authors in previous papers.

Larval morphology, phylogeny, Coleoptera, Silphidae, *Nicrophorus*

INTRODUCTION

Nicrophorus mexicanus Matthews, 1888 is a large necrophagous beetle, active all year round, distributed from southwestern United States to Guatemala and El Salvador (Peck & Anderson 1985).

Building on the classic studies of Hatch (1927), Pukowski (1933, 1934) and Balduf (1935), more recent researches have focussed on the immature stages of *Nicrophorus* Fabricius, 1801 species from both a morphological (Byzova 1964; Klausnitzer & Zerche 1978; Anderson 1982; Peck & Anderson 1985; Růžička 1992) and an ethological (Roussel 1964a, b; Milne & Milne 1944, 1976; Halffter et al. 1983; see also the papers quoted in Huerta et al. 1992) perspective.

The three larval instars of *Nicrophorus mexicanus* are described in this paper in detail, with a view to reexamine the phylogenetic relationships of the species. Our results are compared with those of Peck & Anderson (1985) who placed five species of *Nicrophorus* (*N. hybridus* Hatch & Angell, 1925, *N. investigator* Zetterstedt, 1824, *N. mexicanus*, *N. nigrita* Mannerheim, 1843 and *N. tomentosus* Weber, 1801) – mainly from Latin America – together in the *N. investigator* group. Their study included five characters taken from larval morphoanatomy, which formed the basis of a phylogenetic hypothesis.

MATERIALS AND METHODS

Twelve individuals (5 females and 7 males) from the Chapultepec Wood, Mexico City, Mexico, were included in this study. The individuals were collected during summer 1991 with pitfall traps baited with meat. Five pairs were secluded and reared in controlled conditions in suitable terraria, 30 cm in diameter at the mouth, 42 cm high, 3/4 full of sieved sandy soil, at the Department of Animal Biology, University of Turin, Italy. Ground beef was used as food. Terraria were opened and observed at irregular times depending on the activity of each pair. The five pairs regularly bred so that 6 first instar (L_1), 8 second instar (L_2), and 12 third instar (L_3) larvae were obtained (no pupa was sacrified, so that a description of this stage is not provided). On average the first larval instar took 2 days to develop, the second instar 4 days, the third instar 6 days, and the pupa 25 days.

These data are in keeping with the observations of Halffter et al. (1983) for species raised under laboratory conditions Larvae were dropped into boiling water for about three minutes; subsequently they were fixed in Bouin solution and transferred after two days into 70% ethyl alcohol Some were dissected and mouth parts, antennae, and legs were examined first in glycerine, and then in Canada balsam under the microscope

DESCRIPTION

Larva eruciform and elongate (Fig. 1). Dorsoventrally depressed. Body whitish, third stage more brownish, with the head, strongly reduced ventral sclerites, regions surrounding the spiracles, urogomphi (Figs 1, 18, 38) and legs more sclerotized. Average body length: L_3 27.8 mm, L_2 18.8 mm, L_1 5.2 mm.

HEAD (Figs 11, 12, 13, 29). Prognathous, dorsoventrally depressed. Average width: L_3 2.2 mm, L_2 2.1 mm, L_1 1.0 mm; average length: L_3 1.8 mm, L_2 1.5 mm; L_1 0.9 mm. Epicranial suture short, marked, straight. Frontal suture V-shaped, with branches very divergent, turned laterally near the fovea, and less conspicuous near the insertion of antennae. Frons gently convex and medially more sclerotized. Epistomal suture manifest only laterally. Foveas well marked.

CLYPEUS (Figs 23, 42). Pentagonal in form, separated from labrum by a large unsclerotized band, with about six sensilla and grouped together with three pairs of setae. L_2 and L_1 clypeus less sclerotized than in L_3.

LABRUM. L_1: transverse, slightly convex apically, pentagonal in form, on the whole not very sclerotized. Central part clearly transverse, without a semicircular area. Anteriorly four strong setae, posteriorly six more, less robust, and two sensilla. L_2 and L_3 with anterior central part strongly sclerotized and directed apically, and two unsclerotized bands laterally. Anterolateral angles well-marked. Setae like in L_1. L_2: anterior margin clearly concave in the middle, very sclerotized laterally, semicircular, raised apically with two teeth.

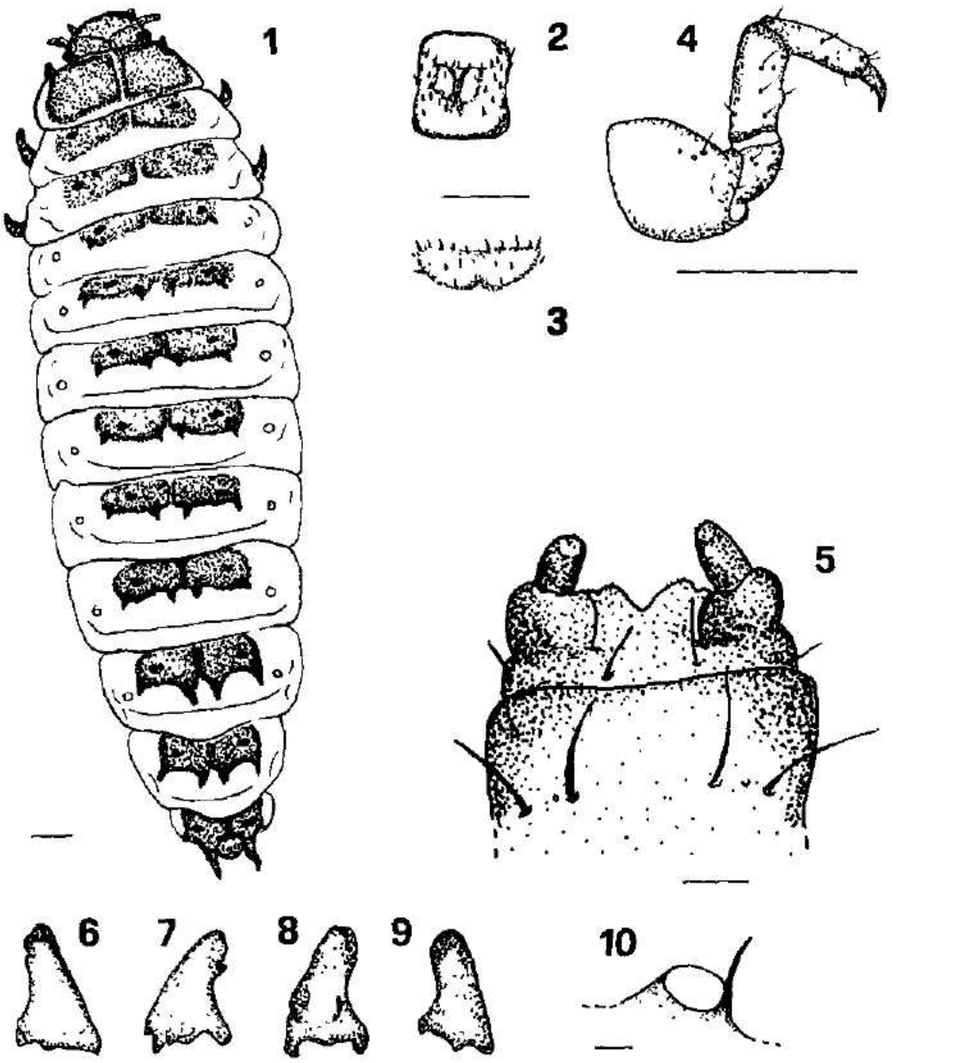
EPIPHARYNX. Two longitudinal bands of dense microtrichia directed centrally; medial part glabrous. L_1: anterior medial part poorly developed, bearing centrally the first porous area, and laterally two strong, conical setae. L_2 (Fig. 25) and L_3: anteromedial concavity more evident. In all instars the first porous area divided by a longitudinal septum and bearing at least three-four pairs of sensilla. Posterior to these the second porous area, pair, with a triad of sensilla. Latero-anteriorly two pairs of conical setae. At the base, between the two longitudinal bands, an irregular, transverse row of variable numbers of sensilla (quinqueporous area) and laterally and posteriorly two groups of five sensilla, in clusters (Fig. 26).

MANDIBLES. Strongly sclerotized. Coarsely pyramid-like, without molar areas. L_3 with spatulate scissorial area in the left mandible (Figs 8, 9), slightly notched, making a small tooth, in the right one (Figs 6, 7). In L_2 mandibles bearing a scissorial area clearly divided by a big median tooth in two parts, each provided with five small teeth. Four hairs dorsolaterally in the right mandible (Figs 21, 22), only one in the left (Figs 19, 20). L_1: mandibles more slender and shorter that in L_2 and L_3. Scissorial areas slightly notched. Externally two hairs, laterally two sensilla (Figs 34, 35).

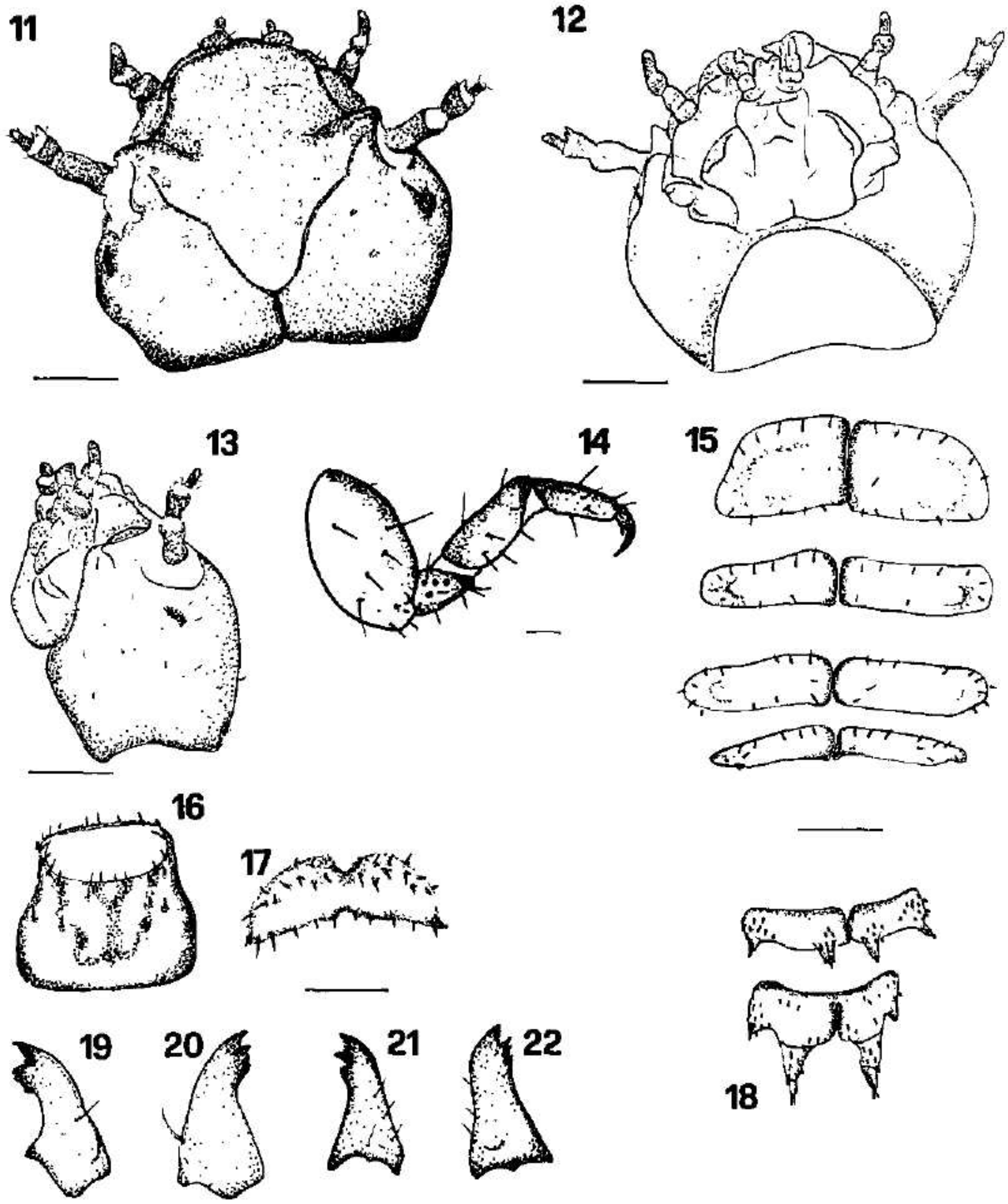
MAXILLAE (Figs 28, 39). The labio-maxillary complex appears more sclerotized in L_3 than in L_1 and L_2. Cardo pyramidal with apex blunt and a posterior seta. Stipes conical, truncated, robust with five primary setae. Palpiger cylindrical, more or less equivalent in size to the first segment of palpi, separated from the maxilla by a small sclerotized area. Palpiger lacking in narrow sclerotized belt and bearing one seta.

Maxillary palpi three-segmented; segments I and II cylindrical, segment III conical. Segment I bearing two flat sensilla; II with two setae and one flat sensillum; III with apical area bearing dense microsensilla and two small setae, one distal and one proximal.

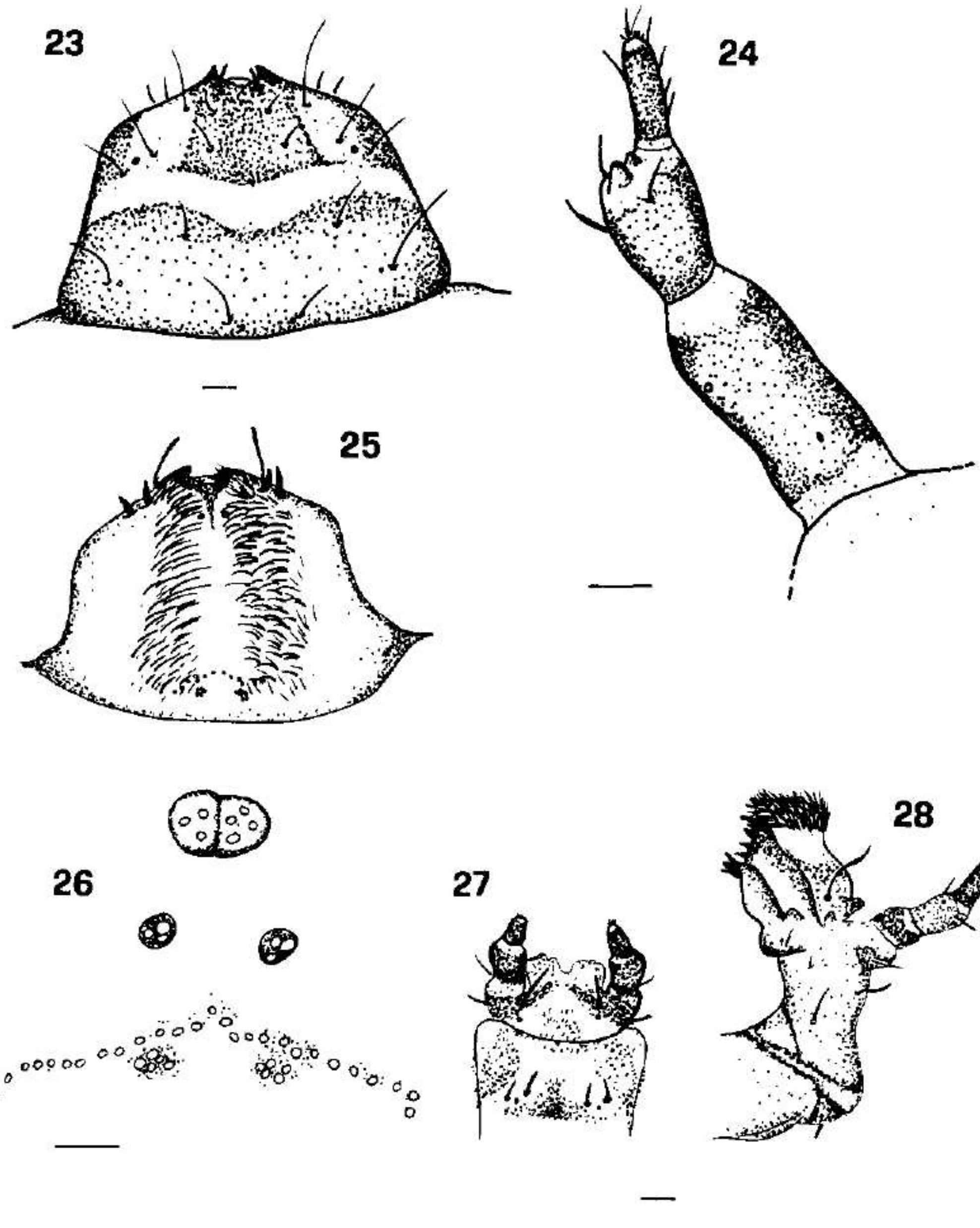
Mala bearing one strong seta inserted on the external edge with a lateral process at the base, small in L_1, stronger in L_2 and L_3. Dorsal process of mala not always clearly visible. Ventral lobe usually small. Inner basal angle sclerotized and pronounced, bearing an area densely covered with microtrichia. Base of galea less sclerotized than mala. Distal area with a transverse row of dense, strong setae. Lacinia narrow and oblong, clearly bilobed. Inner lobe narrow and elongate



Figs 1–10 *Nicrophorus mexicanus* Matthews, L_3. 1 – larva *in toto*, dorsal view, 2 – X abdominal segment, ventral view, 3 – IX abdominal segment, ventral view, 4 – left methathoracical leg, 5 – labium, dorsal view, 6 – right mandible, dorsal view, 7 – right mandible, ventral view, 10 – anular spiracle of mesothoracical epipleuron. Line bars: 1 mm, except figs 5 and 10 (0.1 mm).

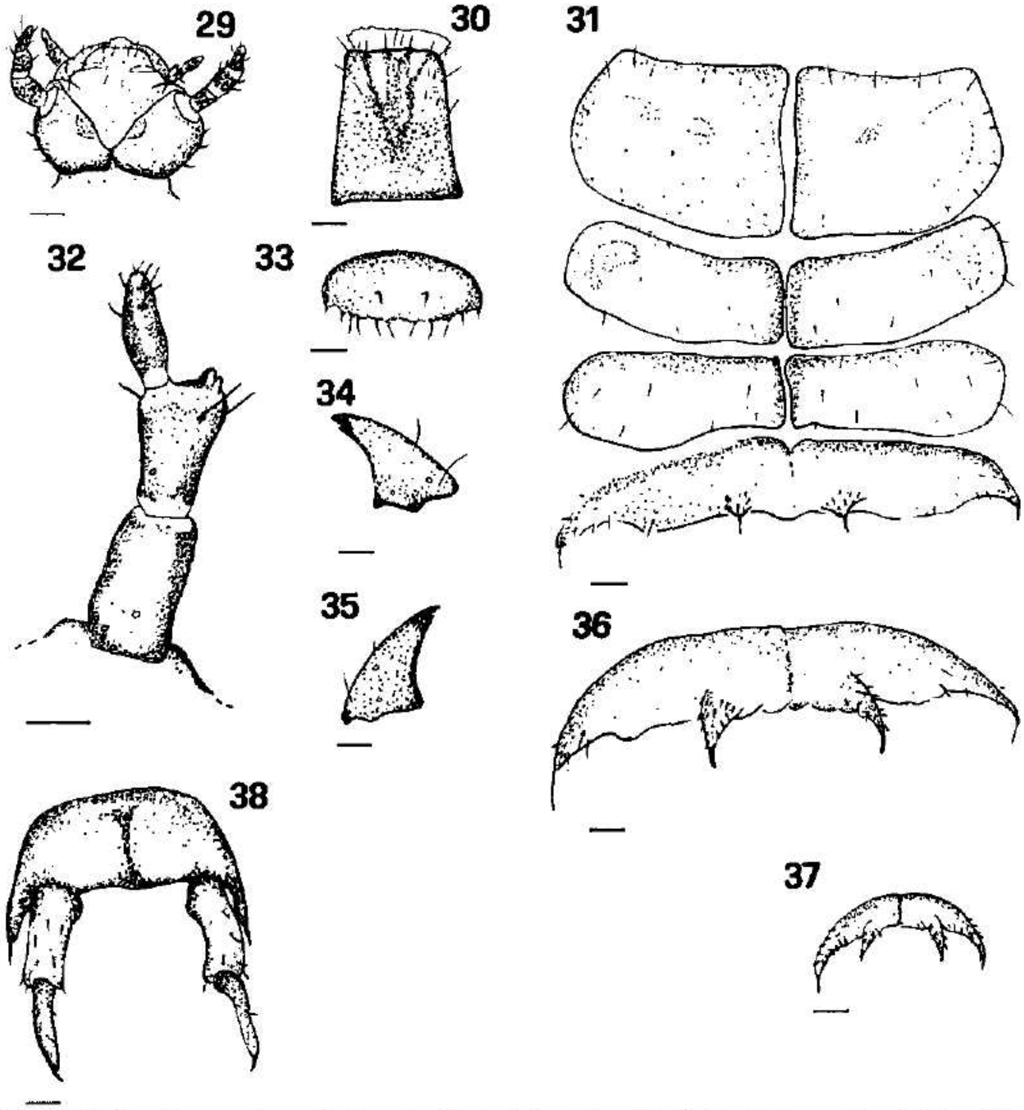


Figs 11–22. *Nicrophorus mexicanus* Matthews, L_2. 11 – head, dorsal view, 12 – head, ventral view, 13 – head lateral view, 14 – left metathoracical leg, 15 – three thoracical and first abdominal dorsal scutal sclerites, 16 – X abdominal segment, ventral view, 17 – IX abdominal segment, ventral view, 18 – VIII and IX abdominal segments, 19 – left mandible, dorsal view, 20 – left mandible, ventral view, 21 – right mandible, ventral view, 22 – right mandible, dorsal view. Line bars: figs 11–13, 16, 17, 19–21: 0.5 mm, fig. 14: 0.1 mm, figs 15 and 18: 1 mm.



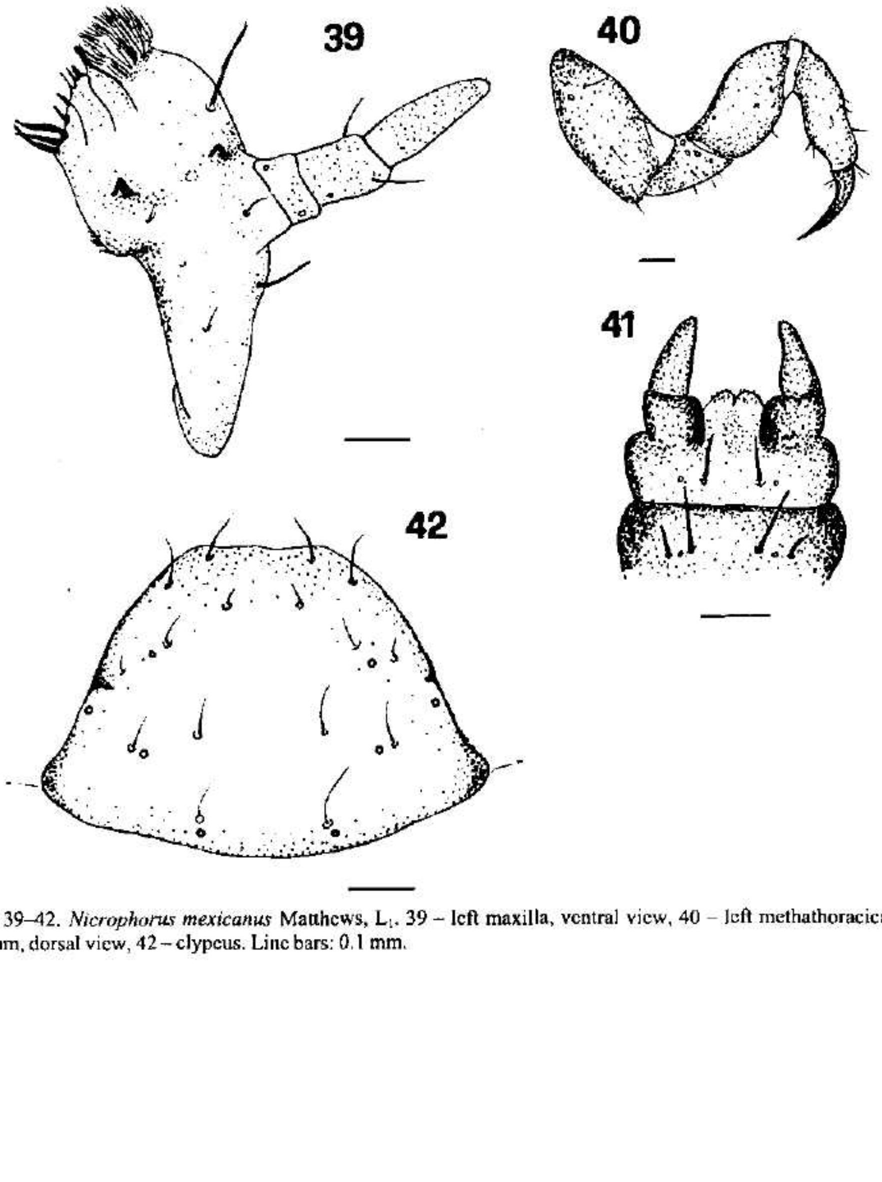
Figs 23–28. *Nicrophorus mexicanus* Matthews, L_1. 23 – clypeus, 24 – antenna, 25 –epipharynx, 26 – basal sensilla of epipharynx, 27 – labium, dorsal view, 28 – maxilla, ventral view. Line bars: 0.1 mm.

with three strong apical teeth and membranous ventral region bearing an area of dense microtrichia. External lobe with five teeth: the tooth close to the galea more developed and stronger. LABIUM (Figs 5, 27, 41). Postmentum truncoconical with three strong setae on each side. Mentum cylindrical, short, with anterior angles rounded, sharp, and two setae on each side separated



Figs 29–38. *Nicrophorus mexicanus* Matthews, L_1. 29 – head, dorsal view, 30 – X abdominal segment, ventral view, 31 – three thoracical and first abdominal dorsal scutal scleres, 32 – antenna, 33 – IX abdominal segment, ventral view, 34 – right mandible, dorsal view, 35 – right mandible, ventral view, 36 – V abdominal segment, 37 – VIII abdominal segment, 38 – IX abdominal segment. Line bars: 0.1 mm.

by a sensorial pore. Praementum transverse, more sclerotized at hind angles that bear one strong seta, and mesally convergent along two distal bands, bearing centrally a pore and a strong seta. Labial palpi two-segmented. Segment I transverse. Ventral surface sclerotized. Segments II and III more elongate, apically unsclerotized and bearing small sensilla. L_1: ligula medially joined, L_2 and L_3 :widely disjoined with thickened and short setae apically.
Antennae (Figs 24, 32). Three-segmented. First segment cylindrical, with at least three sensilla. Second segment swollen and less sclerotized apically, with two proximal sensilla; two more apically, conical and more noticeable, of unequal size; and three setae subapically. Width of the third segment about half that of the second, inserted asymmetrically, bearing 4–5 sparse setae and, apically, two more minute setae and two small microsensilla.
Thorax. Dorsoventrally flattened. Dorsal scutal sclerites strongly sclerotized, medially interrupted. Pronotal sclerite more developed than the other two. Marginal regions with small, primary, reddish setae. L_3: antero-lateral regions with muscle attachments visible as darker spots, not evident in L_2 and L_1. Posterior edge of scutum bearing no lobes or spines (Figs 15, 31).



Figs 39–42. *Nicrophorus mexicanus* Matthews, L_1. 39 – left maxilla, ventral view, 40 – left methathoracical leg, 41 – labium, dorsal view, 42 – clypeus. Line bars: 0.1 mm.

Tab. 1. Characters and character states used to build the phylogenetic tree

	Character	plesiomorphic state (0)	apomorphic state (1)
1	Overwintering stage	adult	prepupa
2	Adult metasternum	lacking bald spot	with bald spot immediately posterior to mesocoxae
3	Adult pronotum	subquadrate to cordate	quadrate
4	Adult metasternal pubescence	yellow	brown
5	Apical part of venter of tenth segment, L_3	sclerotized	unsclerotized
6	Bases of larval labial palpi	widely separated	narrowly separated
7	Suture at base of urogomphus, L_3	complete	absent

Regions of notum close to unsclerotized lateral alar lobe largest and rounded on prothorax. On meso- and metathorax shorter and wedge-shaped, dividing epipleurum into anterior and posterior parts. Anterior epipleuron of mesothorax showing an anular spiracle; a medium size hair inserted on lateral-inner edge of spiracle (Fig. 10); metathorax only with small sclerotized area correspondig to vestigial spiracle on lateral sides.

Pleuron with sclerotized episternum. Proepimeron not sclerotized, meso- and metaepimeron with triangular sclerotized area. On the ventral thoracic surface, the prothoracic praesternum transverse, wide, swollen and with a sclerotized area laterally. L_2: prothoracic praesternum not swollen centrally, and on the whole little sclerotized. Meso- and metathoracic praesterna particularly developed laterally and apparently interrupted medially. Basisterna and sternella of all segments bearing about 40 short, robust, reddish-brown setae. L_2: prothoracic basisternum more flattened medially than in L_3.

ABDOMEN. Ten-segmented. Segments I–V short, dorsoventrally flattened (Fig. 36). Segments VI–VIII gradually longer and narrower, IX considerally modified (Figs 3, 17, 33), X converted into an anal tube (Figs 2, 16, 30). L_2: segments I–IV longer and wider than segments V, VI and VII. Segment VIII clearly longer and narrower (Figs 18, 37).

A transverse suture dividing the notum dorsally into anterior scutal sclerite (praescutum and scutum fused together) and posterior short unsclerotized scutellum. Scutal sclerite about as long as that of metathorax, but distinctly narrower, with paler medial line. L_1: sclerite reaching half the length of the notum, whereas in L_2 and L_3 it reaches the first third only. The posterior margin

Tab. 2. Data matrix

	1	2	3	4	5	6	7
N. fossor	1	0	0	0	0	0	1
N. investigator	1	0	1	0	0	0	0
N. nigrita	1	0	1	1	0	0	0
N. tomentosus	1	1	0	0	1	0	0
N. hybridus	1	1	0	0	1	0	0
N. mexicanus	1	0	1	1	0	1	0
P. morio (outgroup)	0	0	0	0	1	0	0

extended to form one pair each of lateral and dorsal lobes or spines. Spines tubercle-shaped in segments I–II–III; elongate and pointed in remaining ones. Dorsal and lateral spines equivalent, except in segment IX where the dorsal one is clearly longer. Spines bearing a large number of short and dumpy setae. Pleural lobe with a number of small setae and lacking in oval sclerotized areas.

Laterally segments I–VIII bearing one anular, sclerotized spiracle on each side, smaller than mesothoracic ones.

Basisternum with rhomboidal, small, central sclerite, increasing in size from segments II to VIII. L_2: basisternum showing an anterior, vestigial line, whole in the I and II segments, mesally indistinct in remaining ones.

LEGS (Figs 4, 14, 40). Relatively short, heavily sclerotized, except for an unsclerotized medial coxal area. Coxa short, wide and tronco-conical. Trochanter short. Femur and tibiotarsus subequal in length, subcylindrical; the last one narrower. Praetarsus slender, narrow, with two small ventral setae and an arcuate claw. L_2: medial coxal area unsclerotized; tibiotarsus bearing two setae and a crown of sensilla apically.

Identification key of larval instars

To facilitate the identification of the larval instars of *N. mexicanus*, we propose a key based on morphoanatomical characters. The following structures appear to carry most significance: apex of segment X, urogomphi, mandibles, maxillae, labium and antennae.

1 2nd segment of labial palpi twice as long as 1st 3rd segment of maxillary palpi twice as long as 2nd. Lateral external processus of mala minute Lobes of ligula parallel and with distal edges not notched Mandibles simply triangular, with apex narrow and slightly notched. Clypeus little sclerotized with anterior edge rectilineal 1st antennal segment as long as the 2nd Tibiotarsus just longer that praetarsus. Apex of segment X ventrally sclerotized Urogomph swollen . . L_1

1' 2nd segment of labial palpi about as long as the 1st 3rd segment of maxillary palpi about as long as the 2nd Lateral external process of mala well-developed Lobes of ligula clearly distinct with two notches in apical edge Mandible with apex swollen Clypeus very sclerotized with anterior margin medially hollowed 1st antennal segment twice as long as the 2nd Tibiotarsus twice as long as the praetarsus Apex of segment X unsclerotized ventrally 2

2 1st segment of labial palpi just wider than the 2nd Apex of mandible with triangular, small and irregular teeth Clypeus quite sclerotized except for a median C–shaped area . . . . L_2

2' 1st segment of labial palpi clearly wider than the 2nd Apex of mandible frequently rounded through wear. Clypeus very sclerotized and well-developed . . . . L_3

DISCUSSION

Knowledge of the preimaginal instars of *N. mexicanus* supplies us with further characters for assessing the systematic position of this species within the *N investigator* group (sensu Peck & Anderson 1985), in addition to those adult characters that have been reported in the literature.

We generated a ten-character matrix (Tables 1, 2), and analyzed it using both the PAUP 3.0b (Swofford 1989) and Maclade 3.0 (Maddison & Maddison 1992) packages for inferring phylogenies. Character polarities were inferred by outgroup comparison with the only other genus known for the subfamily Nicrophorinae, i. e. the Asiatic *Ptomascopus* Kraatz, commonly regarded as primitive. Following cited literature, we took into account the species *P. morio* Kraatz. The states of characters 6, 7, 8 and 9 were inconsistent among the three larval instars (in keeping with the findings of Růžička (1992) for the palearctic species) and therefore were analyzed separately. For larval instars unavailable to us we referred to the data published by Anderson (1982) and Peck & Anderson (1985). The polarity of characters 6 and 7 was based on the outgroup criterion, used by Peck & Anderson (1985). Our data do not confirm the polarity given by

Růžička (1992), who employed an onthogenetic criterion. Characters were considered as irreversible and the outgroup was used to root the tree. Characters 1, 9, and 10 proved to be uninformative, the last two being autoapomorphies of *N. mexicanus*. The results of our phylogenetic analysis (Fig. 43) allowed us to formulate the following hypotheses:

– according to Peck & Anderson (1985), *N. tomentosus* and *N. hybridus* (both distributed in the Nearctic region) are sister taxa, and they are probably the most primitive species whitin the *N. investigator* group.

– the three remaining species of the group appear to be more derived and closely related.

Nevertheless, our data are not sufficient to analyze relationships among *N. nigrita*, *N. investigator* and *N. mexicanus*, and we will need further information, both on adult and larval morphology, to resolve the polytomy. At this stage of the research, we cannot confirm the phylogenetic hypothesis of Peck & Anderson (1985) (who did not take into account larval characters of *N. mexicanus*). In fact, our matrix supports three phylogenetic trees of the same length (12) and statistics (CI=0,83, RI=0,80, Rescaled CI=0,67), yielding, after a strict consensus analysis, the unresolved tree shown in Fig. 43.

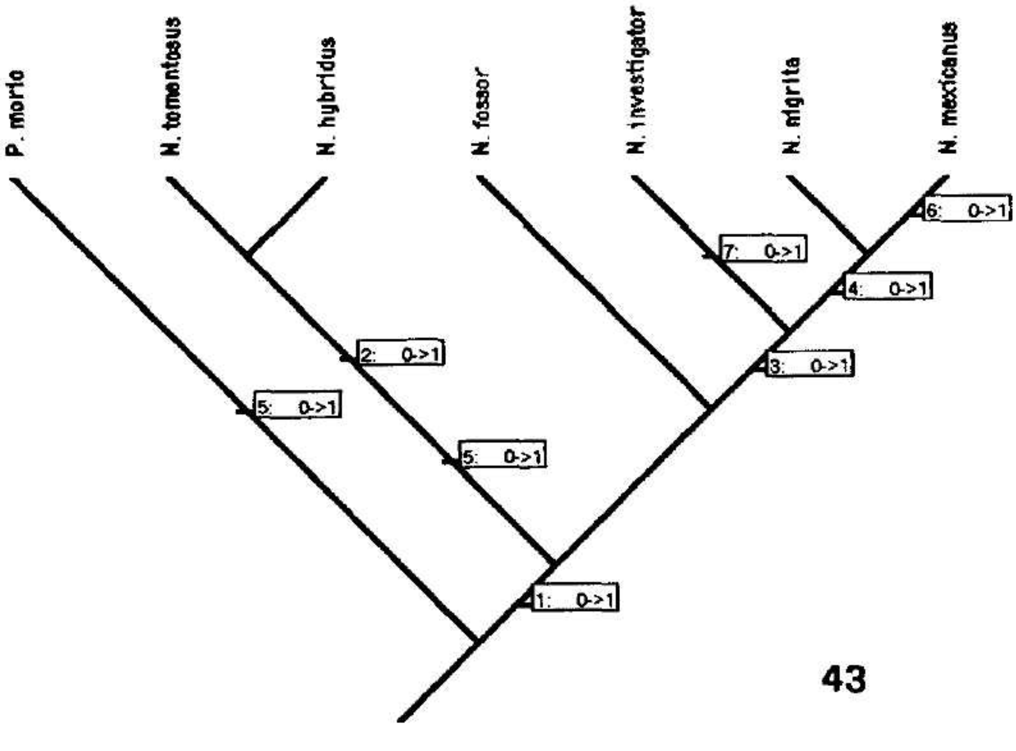


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Fig. 43. Hypothetical phylogenetic relationships among species of the *N. investigator* Zetterstedt group.

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Description of larva of the *Cicindela* (s. str.) *gemmata* (Coleoptera: Cicindelidae) from Russian Far East

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Abstract. Third instar larva of *Cicindela gemmata* Faldermann, 1835 is described and main characters are illustrated. It is compared with L III of *C. silvatica* L., 1758 and *C. sachalinensis* Morawitz, 1862. Larvae of *C. gemmata* are characteristic by having width of pronotum more than 3.7 mm, pronotum has 28–40 setae, hypopleuron with one large and several small anterior sclerites. Key to the six known third instar larvae of *Cicindela* L., 1758 s. str. from Russian Far East are given.

Larval morphology, description, key, Coleoptera, Cicindelidae, Palaearctic region

Description is based on larvae collected during the expedition to Russian Far East in 1991. Some of the larvae were reared till adults in laboratory. Moreover, material from collections of the Zoological Institute of Russia (St. Petersburg) were also studied. Terminology concerning morphology and chaetotaxy was adopted from Knisley & Pearson (1984) and Putchkov & Cassola (1994).

MATERIAL EXAMINED. 17 spec.[L III], Russian Far East, Ussurijsk distr., Kaunovka vill., 13–16.06.1991, Putchkov leg. (in collections of Institute of Zoology of Ukraine, Kiev); 5 spec.[LIII] in the same place, Kryvoy Kluch, 20.07.1937, Richter leg. (in collections of Institute of Zoology of Russia, St. Petersburg).

DESCRIPTION

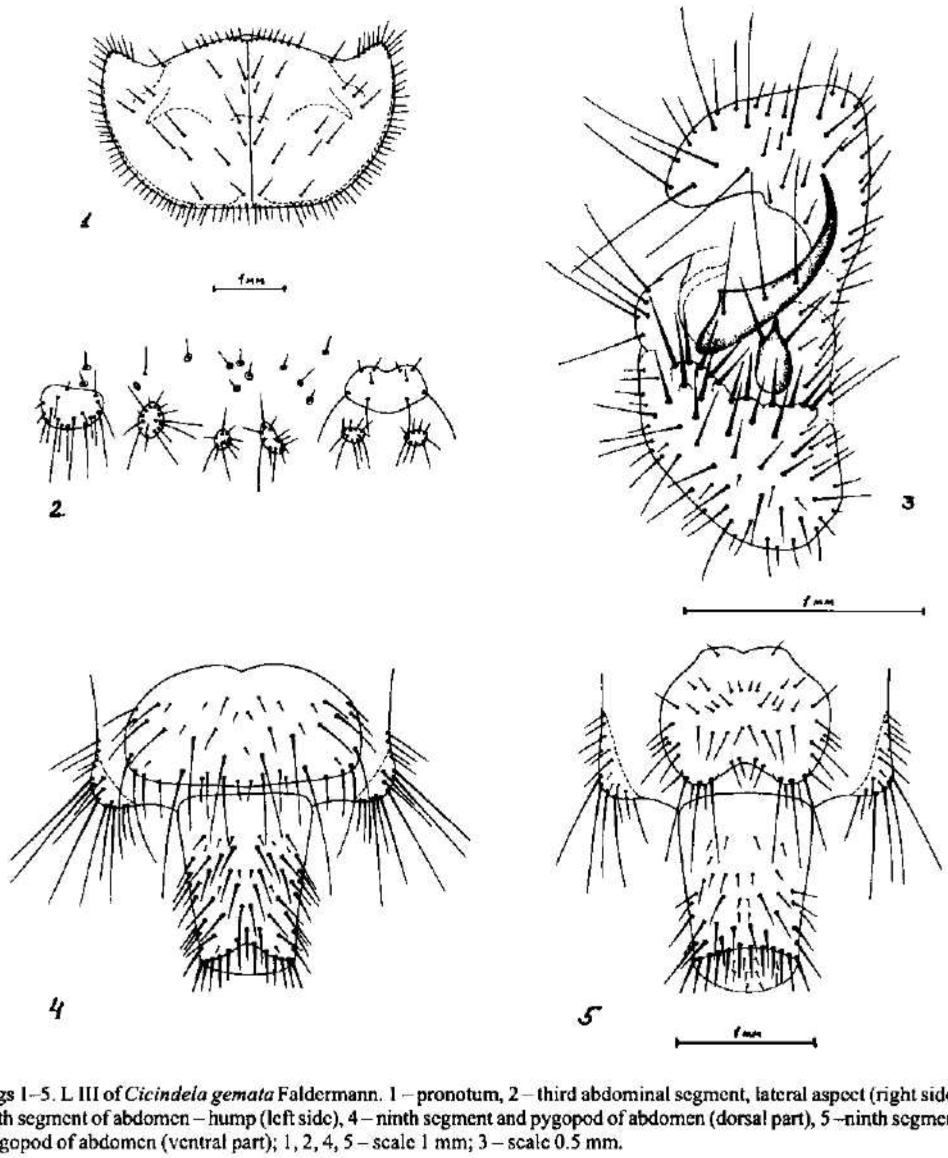
MEASUREMENTS (in mm). Width of fronto-clypeo-lateral area 2.10–2.56 (aver. 2.3), length of fronto-clypeo-lateral area 2.10–2.56 (2.33), width of pronotum 3.91–4.33 (4.24), length of pronotum 2.10–2.68 (2.44).

COLOUR. Dorsal surface of head and mandibles dark brown or nearly black with light bronze-green luster. Other appendages and ventral surface of head brown. Disk of pronotum dark brown with light luster. Cephalolateral angles and lateral margins of pronotum brown. Hooks of hump brown, darkened apically. Setae of head and pronotum nearly white with reddish hue. Setae of abdomen brown.

HEAD. Setation consist mostly from long and thin setae. First segment of antennae with 9–12 setae, second with 10–16 (usually 12–14) setae. First segment of galea with 4–6 setae on inner side. U-shaped ridge low and with 2–3 long setae.

PRONOTUM. Setae long and thin. Callous elevations and ridges of cephalolateral angles very wide, directed slightly outside and no longer than anterior slightly concave margin of pronotum (Fig. 1). One half of pronotum with 14–20 (usually 16) setae, 6–8 setae along median line and 2 (rarely 3) setae on ridges of cephalolateral angles (Fig. 1). Basal and lateral margins without dense rows of setae.

ABDOMEN. Sclerotized areas distinctly expressed. Tergites oval, sternites longitudinally oval. Third and fourth tergites and epipleurites with 17–20 setae. Hypopleuron consist from one large and several small sclerites (Fig. 2). Caudal tergites of hump of fifth abdominal segment with 32–42 stout setae. Lateral tergites slightly separated from caudal tergite and with 7–8 setae. Apical tergites large, nearly half-rounded with numerous setae and usually in contact with caudal tergites on inner margin (Fig. 3). Median hooks widened basally bearing 3–4 setae in first



Figs 1–5. L III of *Cicindela gemata* Faldermann. 1 – pronotum, 2 – third abdominal segment, lateral aspect (right side), 3 – fifth segment of abdomen – hump (left side), 4 – ninth segment and pygopod of abdomen (dorsal part), 5 – ninth segment and pygopod of abdomen (ventral part); 1, 2, 4, 5 – scale 1 mm; 3 – scale 0.5 mm.

half. Median hooks in 2.7–3.3 times longer than inner hooks. Tops of median hooks reaching nearly middle of apical tergites (Fig. 3). Inner hooks with 2 (rarely 3) lateral setae. Central spine strong and no more than in 2.3–2.5 times shorter than lateral setae. Ninth sternites with two groups of 4 (rarely 5) setae on caudal margin. Top of pygopod with 22–26 stout setae. Dorsal and ventral parts of pygopod with numerous setae (Figs 4, 5).

DIFFERENTIAL DIAGNOSIS. Chaetotaxy of head, abdominal segments, hooks of the hump, colouration of head and pronotum of larva of *C. gemmata* are mostly similar to larvae of *C. silvatica* L., 1758 and *C. sachalinensis* Morawitz, 1862. Some differences are presented only in shape and chaetotaxy of pronotum. Larvae of *C. gemmata* are well distinguishable from other species of *Cicindela* s. str. (*C. coerulea* Pallas, 1777, *C. transbaicalica* Motschulsky 1844, *C. restricta* Fischer von Waldhem, 1825, *C. altaica* Gebler, 1829), which occurs in Russian Far East by the colouration and chaetotaxy of pronotum and some abdominal sclerites (see the key).

ECOLOGY. Larvae inhabit sandy loam or loam light soils in forests, usually near rivers. Diameters of the burrows are 5–6 mm, their depth nearly 20–45 cm.

Key to the known third instar larvae of *Cicindela* s. str. from Russian Far East

1(8) Width of pronotum no less than 3.7 mm. Top of pygopod bears no less than 22 stout setae. Head and pronotum usually with light luster only.

2(9) Ninth sternites with 2 group of 4 setae on caudal margin. Pronotum dark brown, sometimes with copper-bronzed luster. Cephalolateral angles of pronotum sometimes lighter than disk. Caudal tergites of hump bear more than 30 stout setae.

3(4) One half of pronotum with 14–20 setae. Hypopleuron consist from one large and several small sclerites. Apical and caudal tergites of fifth abdominal segment in contact on inner margin only . .. . *C. gemmata* Faldermann, 1835

4(3) One half of pronotum bears no more than 10 setae. Hypopleuron consist from two large sclerites. Apical and caudal tergites of fifth abdominal segment fused on inner margin and sometimes in contact on outward side.

5(6) Anterior tergites of abdomen with no less than 20 setae. Second sclerite of hypopleuron with 5–7 setae. Tergites of hump usually completely fused and with numerous setae. Pronotum with not bright dark-green (sometimes violet) luster. Width of pronotum usually more than 4 mm ... ... *C. silvatica* L., 1758

6(5) Anterior tergites of abdomen bear no more than 20 setae. Second sclerite of hypopleuron with 3–4 setae. Tergites of hump sometimes fused, but not in contact on outward side. Pronotum usually with distinct copper-red luster. Width of pronotum rarely more than 4 mm . . . . *C. sachalinensis* Morawitz, 1862

7(2) Ninth sternite with 2 groups of 3 setae on caudal margin. Pronotum light brown with distinct metallic luster. Cephalolateral angles and margin of pronotum yellow. Caudal tergites of hump bear no more than 30 stout setae ... ... *C. coerulea* Pallas, 1777

8(1) Width of pronotum no more than 3.5 mm. Top of pygopod bears no more than 20 stout setae. Head and especially pronotum always with bright metallic luster.

9(10) One half of pronotum with no more than 12 setae. Caudal tergites of hump bear no more than 25 stout setae. Cephalolateral angles of pronotum always lighter than disk . ... *C. transbaicalica* Motschulsky, 1844

10(9) Pronotum with numerous setae (more than 100). Caudal tergites of hump with no less than 25 stout setae. Cephalolateral angles of pronotum no lighter than disk ... ... *C. restricta* Fischer von Waldheim, 1825

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Description of larva of *Cicindela* (s. str.) *coerulea nitida* (Coleoptera: Cicindelidae)

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Abstract. The third instar larva of *Cicindela coerulea nitida* Lichtenstein, 1796 is described and illustrated. It is similar to some known larvae of *C. hybrida* L., 1758 species group. L III of *C. coerulea* Pallas, 1777 is characteristic by having yellow corners of pronotum longer than its anterior margin, width of pronotum more than 3.7 mm, the top of pygopod bears 24–26 setae, head and pronotum with metallic luster, pronotum with 22–30 white setae.

Larval morphology, description, Coleoptera, Cicindelidae, Palaearctic region

Description is based on larvae collected by the junior author in East Siberia (Burjatia, Zoon-Murino vill., Markasan riv., 4–6.09.1974; 28–30.08.1975, 5 ex. [LIII]). Larvae are related to *C. hybrida* L., 1758 species group and have been identified as *Cicindela coerulea nitida* Lichtenstein, 1796 after comparison with other known larvae of the genus and additional knowledge of habitat and distribution areas of the tiger beetles. Terminology concerning morphology and chaetotaxy was adopted from Knisley & Pearson (1984) and Putchkov & Cassola (1994). All material is preserved in Institute of Zoology of Ukraine (Kiev).

DESCRIPTION

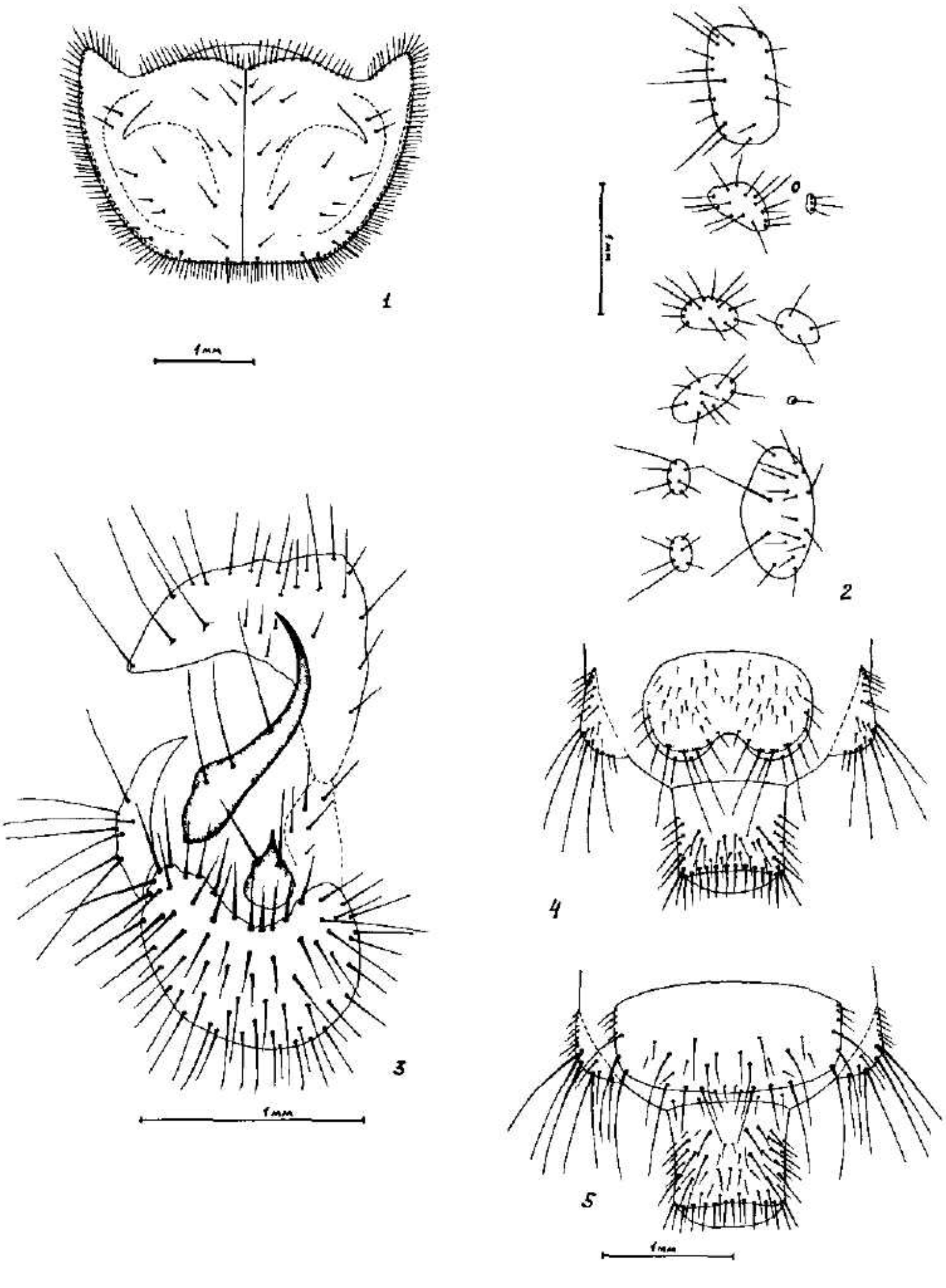
MEASUREMENTS (in mm). Total length 20–28, width of fronto-clypeo-labral area 2.1–2.4, length of fronto-clypeo-labral area 2.1–2.3, width of pronotum 3.7–4.2, length of pronotum 2.1–2.4.

COLOUR. Head dark brown or brown with bronze-green luster. Appendages of head brown (mandibles apically almost black). Pronotum light brown with bright coppery-red metallic luster. Anterior angles and lateral margins of pronotum yellow. Sclerites of abdomen light brown. Hooks of fifth abdominal segment brown, but darkened apically. Setae of head and pronotum white, but on appendages of head and abdomen reddish.

HEAD. Most setae long and thin, a few setae short. First segment of antennae with 7–8 setae, second with 9–12 setae.

PRONOTUM. With two kinds of setae, long and short. Callous elevations and anterior ridges of angles of pronotum distinct. Cephalolateral angles wide and directed forwards, longer than anterior margin of pronotum. One half of pronotum with 10–14 setae, 4–5 setae along median line and 2–3 on ridges of cephalolateral angles (Fig. 1). Basal and lateral margins with very dense rows of setae.

ABDOMEN. Sclerotized areas distinctly expressed. Tergites and sclerites oval. Third and fourth tergites with 14–18 setae. Hypopleuron consists of two large sclerites (Fig. 2). Tergites of fifth abdominal segment transversal and often nearly in contact on inner margin. Caudal tergite with 25–30 stout setae (which are similar to the lateral setae of inner hooks). Lateral tergites with



Figs 1–5. L III of *Cicindela coerulea nitida* Lichtenstein. 1 – pronotum, 2 – third abdominal segment, lateral aspect (right side), 3 – fifth segment of abdomen – hump (left side), 4 – ninth segment and pygopod of abdomen (dorsal part), 5 – ninth segment and pygopod of abdomen (ventral part); 1, 2, 4, 5 – scale 1 mm; 3 – scale 0.5 mm.

7–8 long setae. Median hooks widened basally and with 3–4 thin setae (Fig. 3). Length of median hooks 3.0–3.5 times more than that of inner hooks. Tops of median hooks reach middle of apical tergites. Inner hooks slightly widened basally with 2 (rarely 3) lateral setae. Central spine of inner hooks strong. Its length nearly 3 times less than that of lateral setae. Posterior margin of ninth sternite with 6 long setae (Fig. 5). Top of pygopod with 24–26 setae. For dorsal and ventral parts of ninth segment and pygopod see Figs 4, 5.

DIFFERENTIAL DIAGNOSIS. The larva of *C. coerulea nitida* is morphologically related to some of known larvae of *C. hybrida* L., 1758 species group (*C. hybrida* L.,1758, *C. restricta* Fischer von Waldheim, 1825, *C. altaica* Gebler, 1829) by the shape and chaetotaxy of the hump and pygopod, colouration of the head and pronotum. Resemblance of *C. coerulea* is less as compared with the larvae of *C gemmata* Faldermann, 1835, *C sachalinensis* Morawitz, 1862 and *C. transbaicalica* Motschulsky, 1844 (only chaetotaxy of tergites of the hump is slightly similar to these species). Larva of *C. coerulea* has the following characters which distinguished it from larvae of other *Cicindela* s. str.:

– width of pronotum no less than 3.7 mm;
– margin of pronotum;
– number of the setae on the top of pygopod always more than 23;
– on one half of pronotum no more than 15 setae.

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Description of the third instar larvae of *Anisotoma axillaris* and *A. glabra* (Coleoptera: Leiodidae), with a key to larvae of European *Anisotoma* species

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Abstract Detailed descriptions of the third instar larvae of European species *Anisotoma axillaris* Gyllenhal, 1810 and *A. glabra* (Fabricius, 1792) including the setal pattern are given. A key to the third instar larvae of all five European species of *Anisotoma* Panzer, 1797 is provided.

Morphology, larva, Coleoptera, Leiodidae, *Anisotoma axillaris, A. glabra,* Palaearctic region

INTRODUCTION

The genus *Anisotoma* Panzer, 1797 belongs to the tribe Agathidiini (Leiodidae: Leiodinae; sensu Newton & Thayer 1992) and contains 56 species distributed in Northern and Central America (29 species), Asia (22 species) and Europe (5 species) – Wheeler (1979, 1980, 1983), Hisamatsu (1985), Perkovsky (1987, 1992), Angelini & De Marzo (1986, 1988, 1994, 1995), Švec (1992), Angelini & Švec (1993, 1994) and Angelini & Svec (1995).

Representatives of this genus are known to be obligately associated with Myxomycetes. Both adults and larvae feed on the spores and most species can be bred on mature sporocarps (Wheeler 1984, Newton 1984). Moreover, both adult and larval stages have the molar lobe of mandible covered with dense asperities (more developed in larvae) which are usually interpreted as structures taking part in spore manipulation and crushing (Lawrence & Newton 1980, Wheeler 1984). However, *A. plasmodiophaga* Wheeler, 1980 was observed feeding as well as bred on plasmodia (Wheeler 1980) but the molar asperities are present both in adults and in larvae of this species (Wheeler 1984). Adults of *Anisotoma* are sometimes reported to be found feeding on spores of various Basidiomycetes but no breeding record is so far known (Newton 1984).

Immature stages of the tribe Agathidiini are only poorly known. The review of older papers was given by Angelini & De Marzo (1984) and modified by Wheeler (1990). Unfortunately, most of the papers contain only a brief description with a few, sometimes even incorrectly evaluated characters of significant taxonomic value. The description of all three larval instars of *A. basalis* (LeConte, 1853) from the Nearctic region by Wheeler (1990) is the first detailed description of *Anisotoma* larvae. Wheeler (1990) also introduced a chaetotaxic system based mostly on an arrangement of setae into imaginary longitudinal rows, modifying the system proposed for Staphylinidae: Aleocharinae by Ashe & Watrous (1984). So far, mature larvae of the following three European species were described in detail: *A. humeralis* (Fabricius, 1792) by Ratajczak (1995), *A. orbicularis* (Herbst, 1792) and *A. castanea castanea* (Herbst, 1792) by Ratajczak (1996).

In this paper, a detailed description of the third instar larvae of further two European species *A. axillaris* Gyllenhal, 1810 and *A. glabra* (Fabricius, 1792) is provided and a key to mature larvae of all five European species is given. The larva of *A. glabra* was briefly described by Schiödte (1861) and was treated later several times (e. g. Vaternahm 1917, Böving & Craighead 1930, Henriksen 1968) but only some further taxonomically important details were added. The larva of *A. axillaris* is described for the first time.

MATERIAL AND METHODS

I examined the following larval material:

Anisotoma axillaris: Bohemia mer., Křemže env., Kleť mt. (7151), 2.viii.1986, Petr Švácha leg., on Fagus-stump, larvae of instar III bred from adults, 9 specimens. Two specimens were reared till adults, 1 male specimen was dissected and the identification was verified.

A. glabra. Bohemia mer., Hluboká nad Vltavou (6952), 14.viii.1986, Petr Švácha leg., larvae of instar III bred from adults, 3 specimens; Rossia, Karelia bor., Pojakonda env., 11.vi.1989, Jan Růžička leg., mixed forest, larvae of instar III collected from rests of black Myxomycetes on staying stem of *Pinus* sp., 3 specimens.

The material was preserved in Pampel's fluid (after Švácha & Danilevsky 1987). The dissected larvae were mounted in Canada balsam on permanent slides and examined with a stereoscopic microscope (usually under 450×, maximum under 1000× magnification). All measurements were made using an ocular micrometer. All permanent slides are deposited in the author's collection.

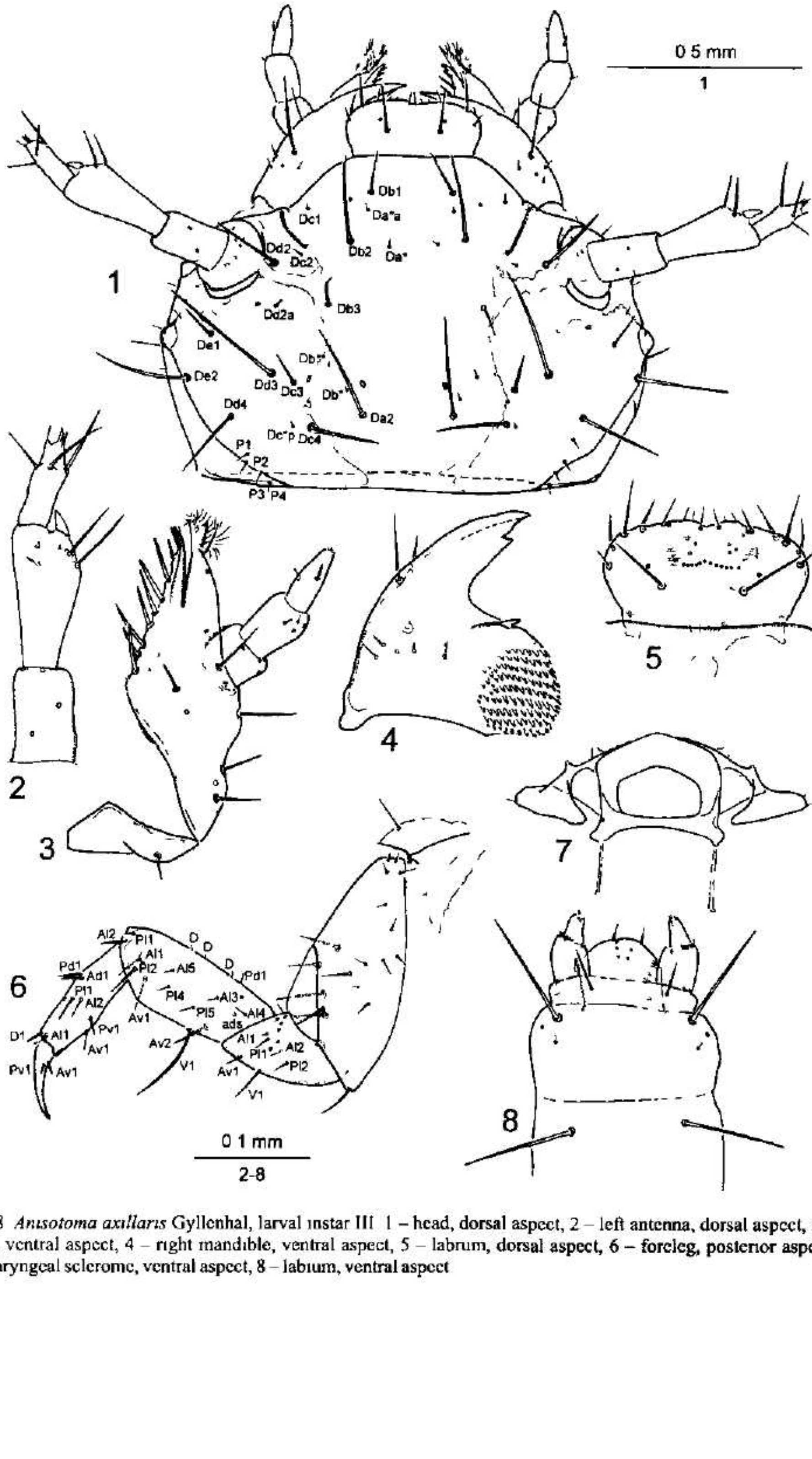
The following abbreviations are used throughout the text (Wheeler 1990, Ratajczak 1996, slightly modified): HL – head length, HW – head width, N1L – pronotal length, N1W – pronotal width, N3L – metanotal length, N3W – metanotal width, A1L – length of abdominal segment I, A1W – width of abdominal segment I, URI – length of urogomphal segment I, URII – length of urogomphal segment II, URS – length of urogomphal apical seta antennal formula = compative lengths of antennomere I antennomere II antennomere III : digitiform organ of antennomere II. Chaetotaxy labelling system is used in accordance with Wheeler (1990) and Ratajczak (1996). In descriptions, the numbers of setae and sensilla are given only for one half of the head or body segments.

Anisotoma axillaris Gyllenhal, 1810

Diagnosis. Two stemmata. Three small solenidia at base of digitiform solenidium of antennomere II, digitiform solenidium large, undivided. Mola (of mandible) with rows of sclerotized dense asperities. Dorsal integument of body with dense asperities, arranged into distinct transverse rows. Head with setae Da1 and Dd1 absent, dorsally with 4 pairs of campaniform sensilla. Antennae comparatively short. Dorsal surface of labrum with a single median pair of setae. Ventral surface of mentum with 1 large and 1 small pairs of setae. Large setae on dorsal surface of thorax and abdomen long and pointed. Pronotum with seta Dd2 present. Dorsal transverse row of mesonotum with 5 setae. Abdominal terga I–VIII with 6 pairs of large setae in posterior row (seta Db1 absent), rarely some terga with only 5+6 large setae (the pairs are usually assymetrical and one seta P3 is absent in this case). Abdominal tergum IX medially divided. Urogomphus comparatively short, segment I about 1.4 times as long as wide, with 7 setae.

Description. Body cylindrical, narrowed posteriorly, widest at metanotum. Total body length 4.0–5.5 mm (average 4.7 mm). Metanotal width 1.07–1.23 mm (average 1.15 mm).

Head (Fig. 1): cranium wider than long; HW/HL = 1.42–1.51; HW = 0.69–0.72 mm. Chaetotaxy as follows: row Da with 3 setae: small setae Da*a and Da* on clypeus, large seta Da2 posteriorly on frons. Row Db with 5–6 setae: large Db1 and Db2 on clypeus, Db3 anterolaterally on frons; Db*, Db** and sometimes also 1 additional seta more medially in postero-lateral part of frons. Row Dc with 5 setae: small Dc1 laterally on clypeus, small Dc2 behind epistomal suture, large Dc3 and Dc4 on epicranium, closely to frontal suture, followed by very small Dc*p laterally to Dc4. Row Dd with 4 setae: larger Dd2 near connecting membrane of antenna, small



Figs 1–8 *Anisotoma axillaris* Gyllenhal, larval instar III 1 – head, dorsal aspect, 2 – left antenna, dorsal aspect, 3 – left maxilla, ventral aspect, 4 – right mandible, ventral aspect, 5 – labrum, dorsal aspect, 6 – foreleg, posterior aspect, 7 – hypopharyngeal sclerome, ventral aspect, 8 – labium, ventral aspect

Dd2a anteriorly on epicranium (sometimes absent), very large Dd3 and large Dd4 on epicranium. Row De with 2 setae: large De1 and very large De2 laterally on epicranium. Lateral row with 1 large and 2 small setae. Posterior margin with 4 setae (P1–P4). Campaniform sensilla include 1 on clypeus (between Da*a and Dc1), 1 on frons (anteriorly from Da2), 2 on epicranium (1 laterally to Dd2a, 1 close to frontal suture between Dc3 and Dc4). Posterior part of frons and epicranium with moderately dense, minute asperities. Stemmata 2, laterally positioned.

Antenna (Fig. 2): antennal formula = 3.1:4.9:3:1. Comparative lengths of antennomere II : digitiform solenidium = 4.9; comparative lengths of antennomere II : antennomere III = 1.6. Antennomere I with 2 dorsal and 2 ventro-apical campaniform sensilla. Antennomere II with 2 dorsal and 1 ventral setae with 1 large, undivided thumb-like digitiform solenidium and 3 small solenidia in ventro-apical membraneous area. Antennomere III with 3 larger subapical setae, with 1 subapical pointed process, with 1 subapical setiform sensillum and 2 apical peg-like sensilla.

Labrum (Fig. 5): subquadrate, lateral margins rounded. Epipharynx with median transverse row of about 13 campaniform sensilla, preceded by 3 pairs of more anteriorly placed and slightly irregularly distributed sensillae; laterally with longitudinal fields of mitrotrichiae. Dorsal surface of labrum medially with 1 pair of large setae and with 1 pair of campaniform sensilla. Lateral margin with 8 pairs of setae (1 lateral, 3 apical and 4 ventro-apical pairs), ventro-apically also with 1 pair of sensilla.

Mandible (Fig. 4): apically bidentate with internal edge serrate; prostheca pointed and sclerotized, basally with a group of regularly distributed, minute ventral spines. Mola distinct, ventrally with ca. 120 visible teeth. Dorsal surface of mandible with 1 large and 4 small setae and with 1 campaniform sensillum, lateral margin with 1 large seta.

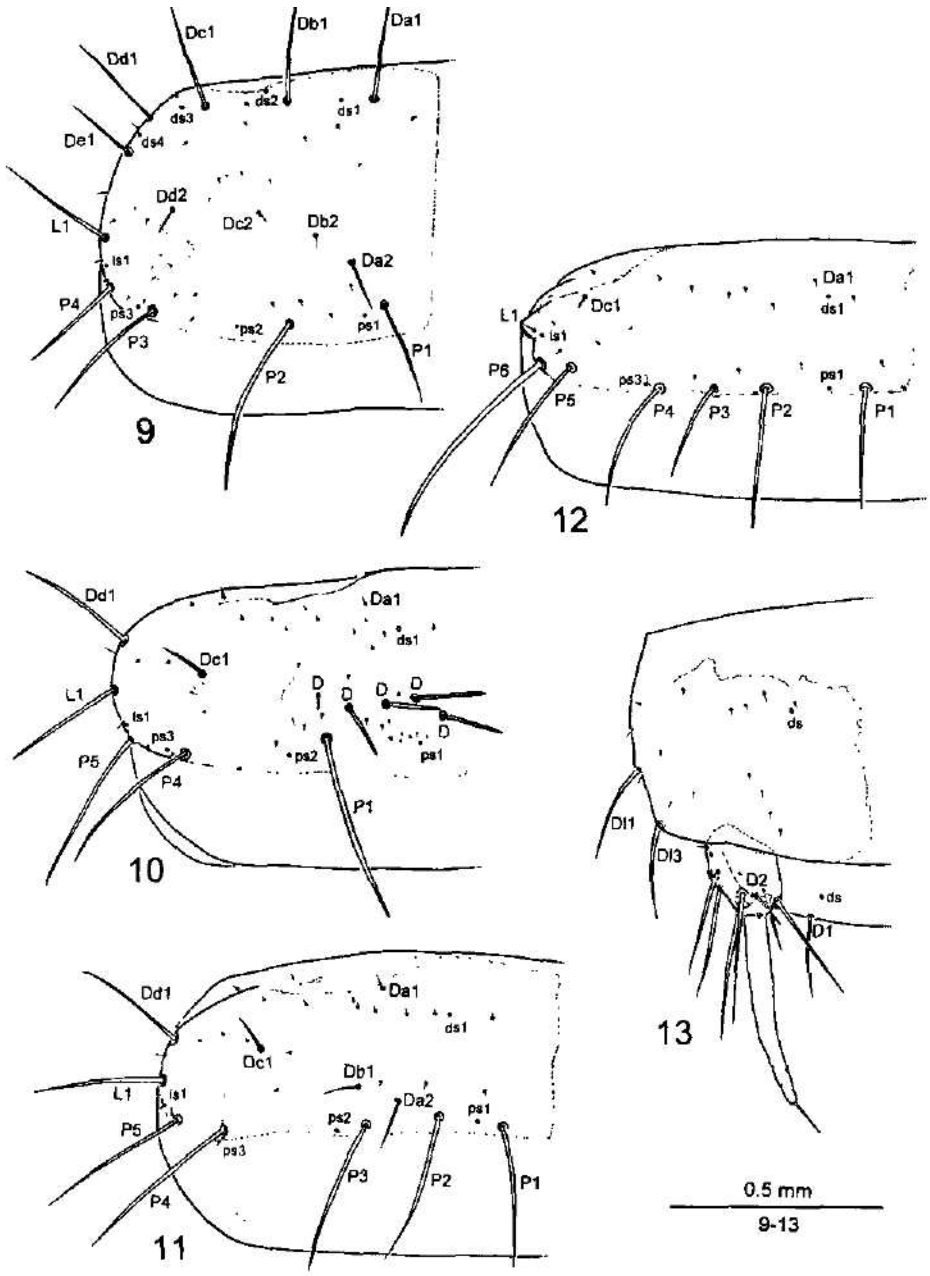
Maxilla (Fig. 3): lacinia lanceolate, with 8–9 mesal spines and a transverse group of small dorsal spines. Galea with fimbrinate, bibranched apex, with 2 subapical setae. Segment I of maxillary palpus dorso-laterally with a group of small spines, comparative lengths of maxillary palpus segments I:II:III = 0.75:0.9:1.

Labium (Fig. 8): comparative lengths of labial palpus segments I:II = 0.95; segment I apically with 1 campaniform sensillum and a group of sensilla; segment II antero-ventrally with 2 campaniform sensilla, antero-dorsally with 1 close-fitting digitiform sensillum and a group of apical sensilla. Praementum with 1 ventral seta and a group of latero-apical sensilla. Ligula dorso-laterally with a pair of serrate lobes, antero-ventrally with 1 pair of small apical setae and 3 pairs of campaniform sensilla. Mentum ventro-laterally with 1 very large and 1 small pair of setae and 1 pair of campaniform sensilla; submentum ventro-laterally with a pair of very large setae. Hypopharyngeal sclerome (Fig. 7) with complete anterior and posterior bridges, strongly sclerotized.

Foreleg (Fig. 6). Coxa: large, with 9 posterior and 8 anterior setae.

Trochanter: triangular, with 2–3 postero-dorsal setae (Pd1, Pd2, sometimes more ventrally with 1 additional seta) and with 2 posterior campaniform sensilla; anteriorly with 1 antero-ventral seta (Av1), 2 antero-lateral setae (Al1, Al2), 1 antero-dorsal seta, 1 ventral seta (V1) and with 4 campaniform sensilla.

Femur: short and broad, with single long ventral seta (V1), with 1 postero-dorsal seta (Pd1) and 2–3 small dorsal setae (D), with 2 larger and 2–3 small postero-lateral setae (Pl1, Pl2; Pl4, Pl5, sometimes with 1 additional seta between Pl4 and Pl5), with 1 postero-dorsal campaniform sensillum (pds); anteriorly with 5 antero-lateral (Al1–Al5) and 2 antero-ventral setae (Av1, Av2) and with 1 antero-dorsal campaniform sensillum (ads).



Figs 9–13. *Anisotoma axillaris* Gyllenhal, larval instar III. 9 – pronotum, dorsal aspect, 10 – mesonotum, dorsal aspect, 11 – metanotum, dorsal aspect, 12 – abdominal tergum I, dorsal aspect, 13 – abdominal tergum IX, uropomphus and anal membrane, dorsal aspect.

Tibia: shorter and more slender than femur, with 1 postero-dorsal seta (Pd1), 1 subapical dorsal seta (D1), 1 postero-lateral seta (Pl1) and 1 postero-ventral seta (Pv1); anteriorly with 1 antero-lateral seta (Ad1), 2 antero-lateral setae (Al1, Al2) and 1 antero-ventral seta (Av1), sometimes with 1 postero-dorsal campaniform sensillum near Pl1.

Tarsungulus: long and pointed, with a single pair of setae (Pv1, Av1).

Pronotum (Fig. 9): transverse, N1L/N1W = 2.0. Chaetotaxy: row Da with 2 setae (Da1, Da2), row Db with 2 setae (Db1, Db2), row Dc with 2 setae (Dc1, Dc2), row Dd with 2 setae (Dd1, Dd2), row De with 1 seta (De1), row L with 1 seta (L1), posterior transverse row with 4 setae (P1–P4); campaniform sensilla include 1 between Da1 and Db1 (ds1), 1 near Db1 (ds2), 1 between Dc1 and Dd1 (ds3), 1 between Dd1 and De1 (ds4), 1 near P1 (ps1), 1 between P2 and P3 (ps2), 1 between P3 and P4 (ps3) and 1 between P4 and L1 (ls1); ca. 12–13 very small setae below Da1–Dd1, ca. 9–12 very small setae above posterior transverse row, ca. 4–5 very small setae laterally between De1 and P4. Pronotal surface with sparse minute asperities, arranged into transverse rows.

Mesonotum (Fig. 10): transverse chaetotaxy as follows: row Da with 1 small seta (Da1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 seta (L1), posterior transverse row with 3 setae (P1, P4, P5), discal transverse row with 5 setae (D); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 posteriorly to the discal transverse row (ps1), 1 laterally to P1 (ps2), 1 between P4 and P5 (ps3), 1 between P5 and L1 (ls1); ca. 10–12 small setae below Da1–Dd1, ca. 15 small setae between discal and posterior transverse rows, only 2 small setae laterally between Dd1 and P5.

Metanotum (Fig. 11): transverse, N3L/N3W = 2.5; chaetotaxy as follows: row Da with 2 setae (Da1, Da2), row Db with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 large seta (L1), posterior row with 5 setae (P1–P5); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 between P1 and P2 (ps1), 1 laterally to P3 (ps2), 1 postero-laterally to P4 (ps3), 1 between P5 and L1 (ls1); ca. 14 small setae posteriorly to Da1, ca. 5 small setae between P1 and P5, 2 small setae laterally between Dd1 and P5.

Abdominal tergum I (Fig. 12): A1L/A1W = 2.7; chaetotaxy as follows: row Da with 1 very small seta (Da1), row Dc with 1 seta (Dc1), row L with 1 small seta (L1), posterior row with 6 setae (P1–P6); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 between P1 and P2 (ps1), 1 laterally to P4 (ps3) and 1 postero-medially to L1 (ls1); ca. 8 very small setae between and posteriorly to Da1 and Dc1, ca. 8 very small setae between P1 and P6.

Abdominal tergum IX (Fig. 13): with 2 dorso-lateral setae (Dl1, Dl3), 1 campaniform sensillum (ds) and 15 small setae.

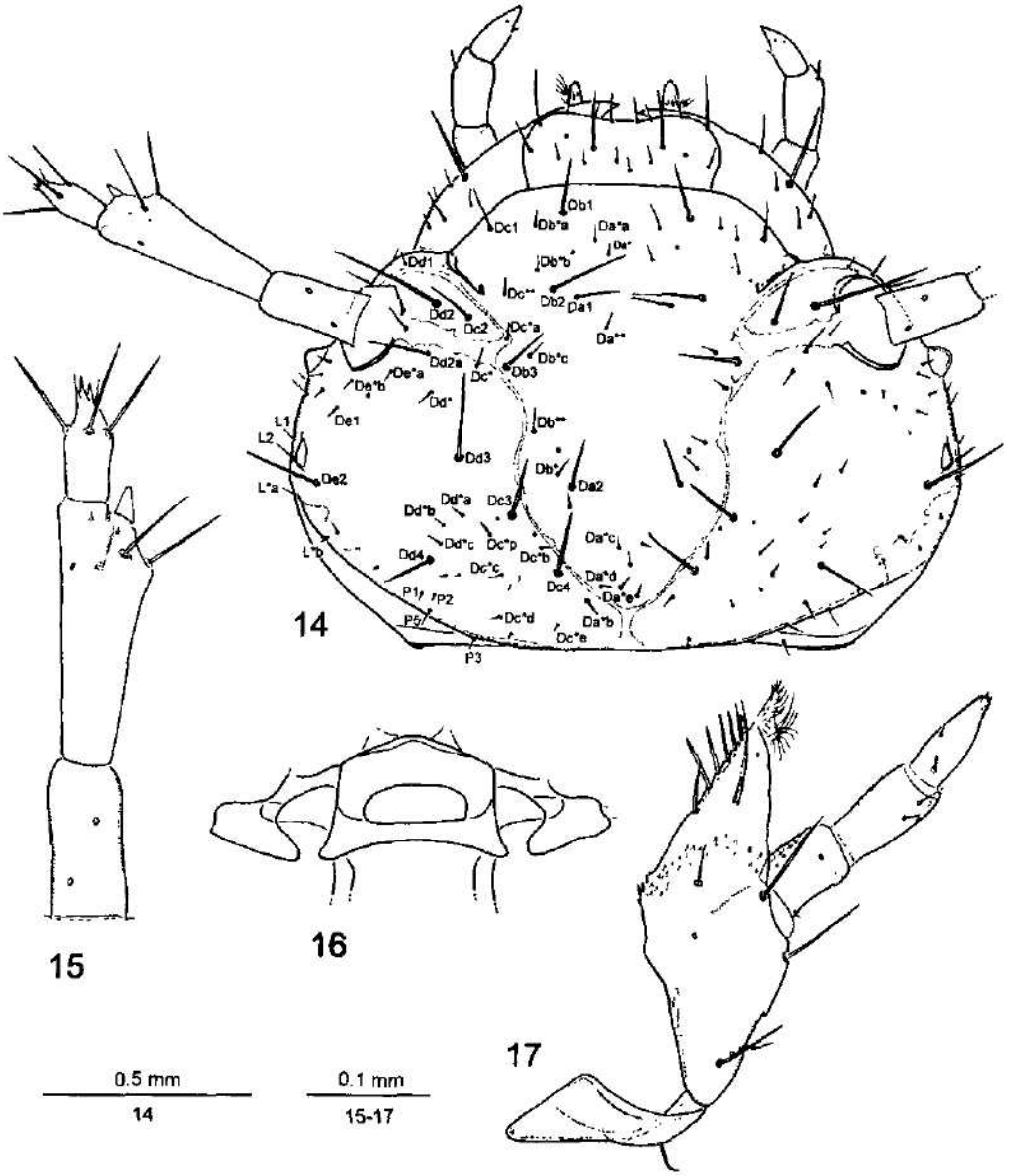
Urogomphus (Fig. 13): comparatively short; comparative lengths of URI:URII:URIII = 2.4:4 7:1. Urogomphal segment I about 1.4 times as long as wide, with 3 large dorsal, 3 large ventral and 1 small ventro-lateral setae, dorsally with 4–5 campaniform sensilla. Urogomphal segment II with 1 apical seta. Dorsal side of segment I with sparse asperities.

Abdominal sternum IX and anal membrane (Fig. 13): abdominal sternum IX with 1 very small antero-medial seta and posterior transverse row of 5 larger setae. Dorsum of anal membrane with 2 larger setae (D1, D2) and 1 campaniform sensillum antero-medially to D1; ventrally with ca. 11 pairs of small setae and 1 campaniform sensillum.

Anisotoma glabra (Fabricius, 1792)

DIAGNOSIS. Two stemmata. Three small solenidia at base of digitiform solenidium of antennomere II, digitiform solenidium large, undivided. Mola (of mandible) with rows of sclerotized

dense asperities. Dorsal integument of body with dense asperities, arranged into honeycomb-like figures. Head with setae Da1 and Dd1, with numerous additional small setae and with 5 pairs of campaniform sensilla. Antennae comparatively long. Dorsal surface of labrum with 3 median pairs of setae. Ventral surface of mentum with 1 large and 2 medium pairs of setae. Large setae on dorsal



Figs 14–17. *Anisotoma glabra* (Fabricius), larval instar III. 14 – head, dorsal aspect, 15 – left antenna, dorsal aspect, 16 – hypopharyngeal sclerome, ventral aspect, 17 – left maxilla, ventral aspect.

surface of thorax and abdomen short and stout, apically truncated. Terga with numerous additional very small setae. Pronotum with seta Dd2 present. Dorsal transverse row of mesonotum with 2 setae. Abdominal terga I–VIII with 5 pairs of large setae (setae Dd1 and P3 absent). Femur with additional small postero- and antero-lateral setae. Tibia with additional setae Pv2, Av2 and D2. Abdominal tergum IX medially divided. Urogomphus comparatively strongly prolonged, segment I about 6.1 times as long as wide, with 15 setae.

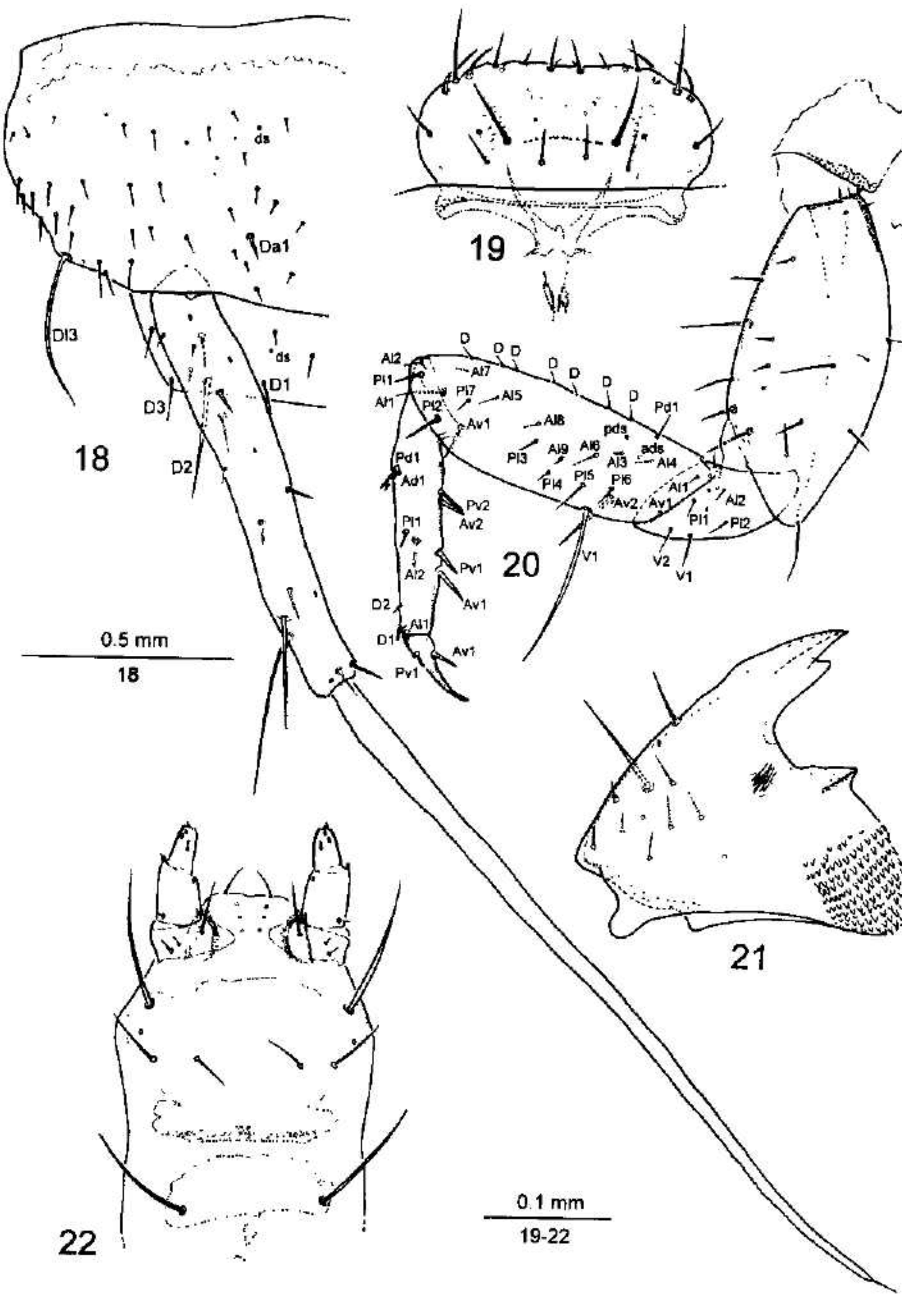
DESCRIPTION. Body cylindrical, narrowed posteriorly, widest at metanotum. Total body length 5.5–6.5 mm (average 6.0 mm). Metanotal width 1.23–1.38 mm (average 1.32 mm).

Head (Fig. 14): cranium wider than long; HW/HL = 1.41; HW = 0.90–0.93 mm. Chaetotaxy as follows: row Da with 7–13 setae: small setae Da*a (sometimes absent), Da* and larger Da1 on clypeus, small Da** (sometimes absent) anteriorly on frons, large seta Da2 on frons, posteriorly with a group of 2–7 small setae (usually three – Da*c, Da*d and Da*e), epicranium posteriorly with small seta Da*b. Row Db with 8–12 setae: clypeus with large Db1 and small Db*a, Db* and sometimes with 1 additional small seta; frons with large seta Db3 and 1–3 antero-lateral small setae (Db*c and 1–2 additional setae, usually absent) and with 2–3 more posteriorly situated, small setae (Db*, Db** and 1 additional seta, usually absent). Row Dc with 10–13 setae: larger seta Dc1 and small Dc** laterally on clypeus, medium Dc2 behind the epistomal suture, small Dc* anteriorly on epicranium; posteriorly on epicranium with 2 large setae (Dc3, Dc4) and a group of 4–7 small setae (Dc*p, Dc*b, Dc*d, Dc*e and sometimes up to 3 additional very small setae). Row Dd with 10–14 setae: small seta Dd1 anteriorly on epicranium before the antennal insertion, very large seta Dd2 and 2 smaller setae (Dd2a, Dd2b) near antennal insertion, more posteriorly 1–3 small setae (Dd* and sometimes 1–2 additional small setae), large seta Dd3 and Dd4 discally on epicranium, between them with a group of 3–5 small setae (Dd*a–Dd*c and sometimes 2 additional setae). Row De with 4 setae: epicranium with 3 small (De*a, De*b and De1) and 1 large lateral seta (De2). Lateral row with about 6 small setae. Posterior margin with 4–5 setae (P1–P3, P5, sometimes 1 additional small seta). Campaniform sensilla include 1 on clypeus (between Db1 and Db2), 1 on frons (anteriorly from Da2), 2 on epicranium (1 between De*a and De*b, 1 close to frontal suture between Dc3 and Dc4). Dorsal side completely covered by asperities arranged into honeycomb-like figures. Stemmata 2, laterally positioned.

Antenna (Fig. 15): antennal formula = 3.2:5.9:2.1:1. Comparative lengths of antennomere II: digitiform solenidium = 5.9; comparative lengths of antennomere II : antennomere III = 2.8. Antennomere I with 2 dorsal campaniform sensilla. Antennomere II with 2 dorsal and 1 ventral setae; with 1 dorsal campaniform sensillum; with 1 large, undivided thumb-like digitiform solenidium and with 3 small solenidia in ventro-apical membraneous area. Antennomere III with 3 larger subapical setae, with 1 subapical pointed process, with 1 subapical setiform sensillum and 2 apical peg-like sensilla.

Labrum (Fig. 19): subquadrate, lateral margins rounded. Epipharynx with median transverse row of about 15 campaniform sensilla, preceded by 2 pairs of more anteriorly placed and slightly irregularly distributed sensillae; antero-laterally with small fields of microtrichiae. Dorsal surface of labrum medially with 1 pair of large setae and 2 pairs of small setae and with 1 pair of campaniform sensilla. Lateral margin with 8 pairs of setae (1 lateral, 3 apical and 4 ventro-apical pairs), ventro-apically also with 1 pair of sensilla.

Mandible (Fig. 21): apically bidentate with internal edge very slightly serrate; prostheca robust, pointed and sclerotized, basally with a group of minute ventral spines in an unsclerotized field. Mola distinct, ventrally with ca. 150 visible teeth. Dorsal surface of mandible with 1 large and 5–7 small setae and with 2 campaniform sensilla, lateral margin with 1 large seta.



Figs 18–22. *Anisotoma glabra* (Fabricius), larval instar III. 18 – abdominal tergum IX, uropomphus and anal membrane, dorsal aspect, 19 – labrum, dorsal aspect, 20 – foreleg, posterior aspect, 21 – right mandible, ventral aspect, 22 – labium, ventral aspect.

Maxilla (Fig. 17): lacinia lanceolate, with 7–9 mesal spines and with a transverse group of small dorsal spines. Galea with fimbrinate, bibranched apex, subapical setae absent. Maxillary palpus relatively long, with a group of small spines dorso-laterally on segments I and II, comparative lengths of maxillary palpus segments I:II:III = 0.9:1.3:1.

Labium (Fig. 22): comparative lengths of labial palpus segments I:II = 1.3; segment I basally with 1 small ventral seta, apically with 1 campaniform sensillum and a group of sensilla; segment II antero-ventrally with 2 campaniform sensilla, antero-dorsally with 1 close-fitting digitiform sensillum and a group of apical sensilla. Praementum with 1 larger and 2 small ventral setae. Ligula dorso-laterally with a pair of serrate lobes, antero-ventrally with 1 pair of small apical setae and 3 pairs of campaniform sensilla. Mentum ventro-laterally with 1 very large and 1–2 smaller pairs of setae and 1 pair of campaniform sensilla; submentum ventro-laterally with a pair of very large setae. Hypopharyngeal sclerome (Fig. 16) with complete anterior and posterior bridges, strongly sclerotized.

Foreleg (Fig. 20). Coxa: large, with 13 posterior and 6 anterior setae and 1 anterior campaniform sensillum.

Trochanter: triangular, with 2 postero-dorsal setae (Pl1, Pl2) and with 2 posterior campaniform sensilla; anteriorly with 1 antero-ventral seta (Av1), 2 antero-lateral setae (Al1, Al2), 1 antero-dorsal seta, 2 ventral setae (V1,V2) and with 4 campaniform sensilla.

Femur: long and broad, with single ventral seta (V1), 1 postero-dorsal seta (Pd1) and 5-7 small dorsal setae (D), with 2 larger and 5–6 small postero-lateral setae (Pl1, Pl2; Pl3–Pl7, sometimes an additional seta is present between Pl3 and Pl7), with 1 postero-dorsal campaniform sensillum (pds); anteriorly with 1 large and 7–8 small antero-lateral setae (Al1; Al2–Al9), 2 large antero-ventral setae (Av1, Av2) and with 1 antero-dorsal campaniform sensillum (ads).

Tibia: only slightly shorter than femur, slender, with 1 postero-dorsal seta (Pd1), 2 subapical dorsal setae (D1, D2), 1 postero-lateral seta (Pl1) and 2 postero-ventral setae (Pv1, Pv2); anteriorly with 1 antero-dorsal seta (Ad1), 2 antero-lateral setae (Al1, Al2) and 2 antero-ventral setae (Av1, Av2).

Tarsungulus: long and pointed, with a single pair of setae (Pv1, Av1).

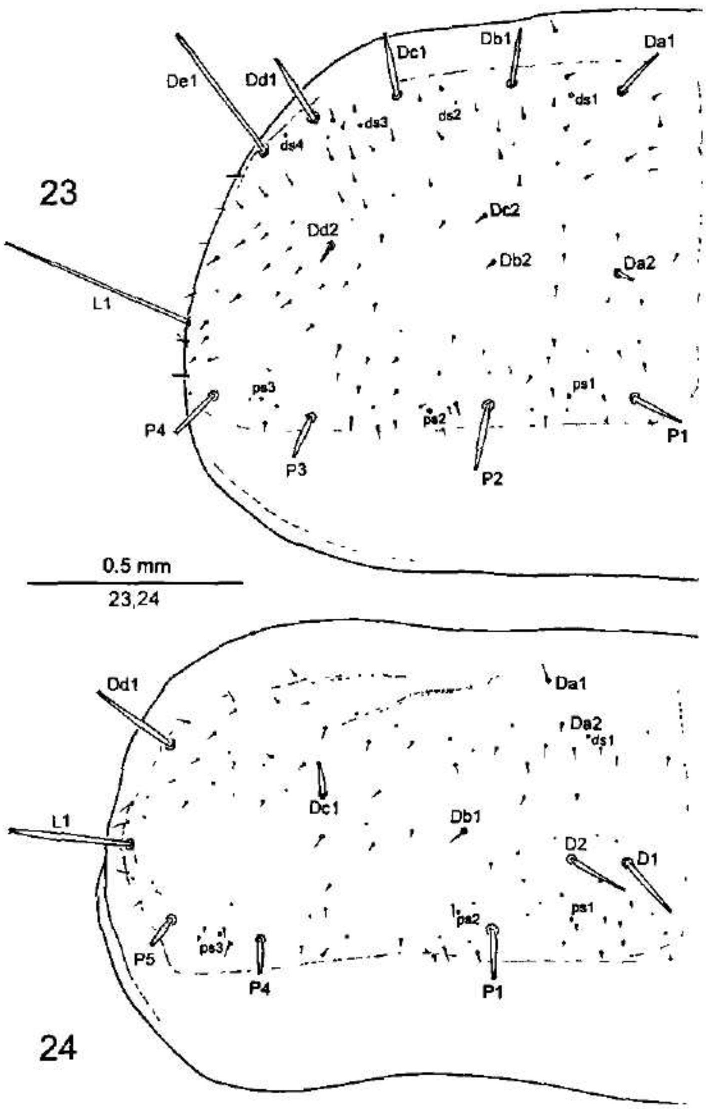
Pronotum (Fig. 23): transverse, N1L/N1W = 1.8. Chaetotaxy: row Da with 2 setae (Da1, Da2), row Db with 2 setae (Db1, Db2), row Dc with 2 setae (Dc1, Dc2), row Dd with 2 setae (Dd1, Dd2), row De with 1 seta (De1), row L with 1 seta (L1), posterior transverse row with 4 setae (P1–P4); campaniform sensilla include 1 between Da1 and Db1 (ds1), 1 between Db1 and Dc1 (ds2), 1 between Dc1 and Dd1 (ds3), 1 between Dd1 and De1 (ds4), 1 between P1 and P2 (ps1), 1 between P2 and P3 (ps2) and 1 between P3 and P4 (ps3); ca. 30–35 small setae below Da1–Dd1, ca. 40–45 small setae above posterior transverse row and ca. 12–15 small setae laterally between De1 and P4. Pronotal surface with dense minute asperities, arranged into honeycomb-like figures.

Mesonotum (Fig. 24): transverse chaetotaxy as follows: row Da with 2 small setae (Da1, Da2), row Dd with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 seta (L1), posterior transverse row with 3 setae (P1, P4, P5), discal transverse row with 2 setae (D1, D2); campaniform sensilla include 1 medially to Da2 (ds1), 1 posteriorly to D2 (ps1), 1 laterally to P1 (ps2), 1 between P4 and P5 (ps3); ca. 35 very small setae posteriorly to Da1–Dd1, ca. 35–40 very small setae between discal and posterior transverse rows, ca. 8 small setae laterally between Dd1 and P5.

Metasternum (Fig. 25): transverse, N3L/N3W = 2.1; chaetotaxy as follows: row Da with 1 seta (dDa1), row Db with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row

L with 1 seta (L1), posterior transverse row with 5 setae (P1–P5); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 posteriorly to P2 (ps1), 1 between P3 and P4 (ps2), 1 between P4 and P5 (ps3); ca. 30 very small setae posteriorly to Da1, ca. 30 very small setae between P1 and P5, ca. 6 small setae laterally between Dd1 and P5.

Abdominal tergum I (Fig. 26): A1L/A1W = 3.9; chaetotaxy as follows: posterior transverse row with 5 setae (P1, P2, P4–P6); campaniform sensilla include 1 anteriorly (ds1), 1 between P1



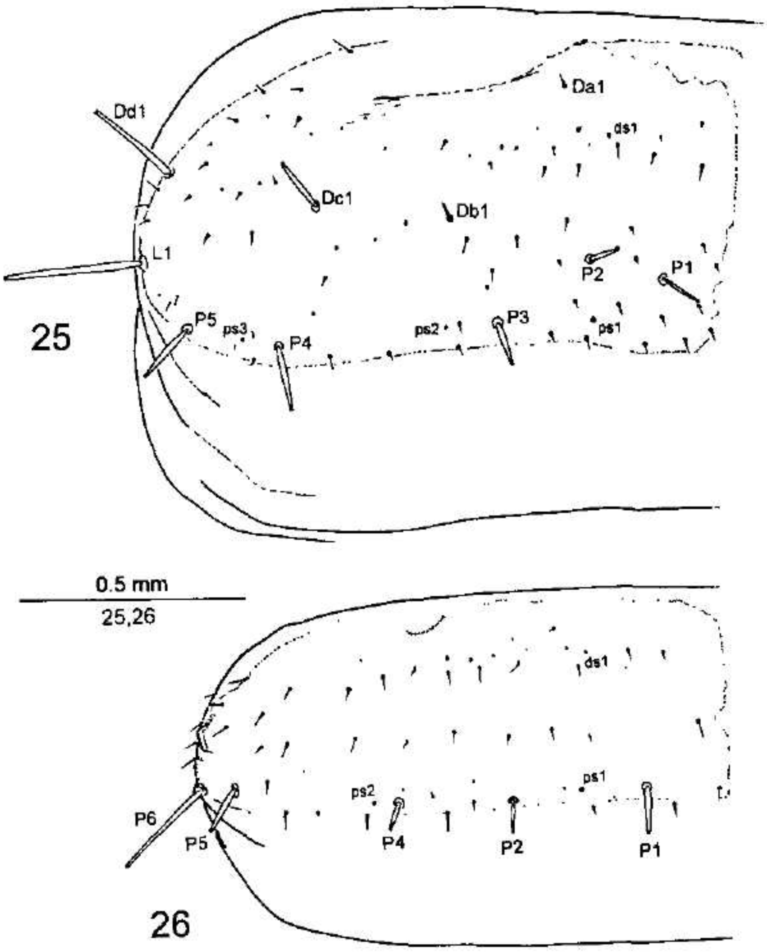
Figs 23–24 *Anisotoma glabra* (Fabricius), larval instar III. 23 – pronotum, dorsal aspect, 24 – mesonotum, dorsal aspect

and P2 (ps1), 1 laterally to P3 (ps2); ca. 20–25 very small setae anteriorly, ca. 15 very small setae between and before P1 and P6, ca. 6 small setae laterally.

Abdominal tergum IX (Fig. 18): with 1 postero-medial larger seta (Da1) and 1 dorso-lateral seta (Dl3), with 1 campaniform sensillum (ds) and ca. 35 small setae.

Urogomphus (Fig. 18): comparatively very long; comparative lengths of URI:URII:URIII = 15.7:28.1:1. Urogomphal segment I about 6.1 times as long as wide, with 4 dorsal, 8 ventral and 2 small lateral setae, dorsally with 5 campaniform sensilla. Urogomphal segment II with 1 apical seta. Surface asperities arranged into transverse, short rows on both sides of segment I, basal part of segment II also with minute asperities.

Abdominal sternum IX and anal membrane (Fig. 18): abdominal sternum IX with 1 small antero-medial seta, posterior transverse row of 5 larger setae and a group of 8 anterior setae.



Figs 25–26. *Anisotoma glabra* (Fabricius), larval instar III. 25 – metanotum, dorsal aspect, 26 – abdominal tergum I, dorsal aspect.

Dorsum of anal membrane with 3 larger setae (D1–D3), 3 smaller setae and 1 campaniform sensillum placed antero-medially to D1; ventrally with ca. 21 small setae and 2 campaniform sensilla.

A key to the third instar larvae of European *Anisotoma* species

The following key is based on a reared larval material of instar III of all 5 European species (dissected and mounted on permanent slides) as well as on papers of Ratajczak (1995, 1996).

1 Urogomphi comparatively short, segment I 1.4–1.5 times as long as wide. Body dorsum with dense asperities, arranged into distinct transverse rows 2
– Urogomphi comparatively long, segment I 3.0–6.1 times as long as wide. Body dorsum either with honeycomb-like asperities, or glabrous, without asperities 3
2 Pronotum with seta Dd2 absent (Fig. 9). Posterior transverse row on abdominal terga I–VIII with 7 pairs of setae (seta Db1 present and shifted to posterior row), exceptionally with only 6+7 setae on few segments (usually assymetrically) .... *A. humeralis*
– Pronotum with seta Dd2 present. Posterior transverse row on abdominal terga I–VIII with only 6 pairs of setae (seta Dd1 absent, Fig. 12), exceptionally few segments with only 5+6 setae (one seta P3 also absent in this case, usually assymetrically) .... *A. axillaris*
3 Head with seta Dd1 absent. Labrum with 1 pair of medial setae. Dorsal surface of thorax and abdomen with very long, pointed setae (setae Db1, P3, P4 and L1 on pronotum longer than the sclerotized part of pronotum) .... *A. orbicularis*
– Head with seta Dd1 present. Labrum with 3–4 pairs of medial setae. Dorsal surface of thorax and abdomen either with moderately long, pointed setae (setae Db1, P3, P4 and L1 on pronotum about 0.5 times as long as the sclerotized part of pronotum), or the setae are short and truncate 4
4 Thorax and abdomen dorsally with moderately long, pointed setae. Dorsum without asperities. Pronotum with seta Dd2 absent. Posterior transverse row on abdominal terga I–VIII with 6 pairs of setae, seta P3 present .... *A. castanea castanea*
– Thorax and abdomen dorsally with short, truncate setae. Dorsum with honeycomb-like asperities. Pronotum with seta Dd2 present. Posterior transverse row on abdominal terga I–VIII with 5 pairs of setae, seta P3 absent .... *A. glabra*

According to Wheeler (1990), the third instar larvae of *Anisotoma* can be characterized by the presence of 3 small solenidia ventrally near the base of large thumb-like, digitiform, ventro-apical solenidium on antennomere II (Figs 2,15). Another character mentioned by Wheeler (1990) – the presence of seta P3 in transverse setal row of abdominal tergum I – can not be used as a generic character for *Anisotoma* as the seta P3 is absent in larvae of *A. glabra* (Fig. 26).

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Larval morphology and notes on bionomy of *Myas chalybaeus* (Coleoptera: Carabidae)

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Abstract. The biological cycle of *Myas chalybaeus* (Palliardi, 1825) is described. *M. chalybaeus* is a typical autumn-breeder with winter larvae and the adult phenogram is very similar to that of *Calathus* Bonelli, 1810. In particular, the larval morphology of specimens obtained from pit-fall traps and „ex ovipositione" has received considerable attention, and some remarks are made on the state of its larval characters.

Larval morphology, bionomy, Coleoptera, Carabidae, Pterostichini, *Myas chalybaeus*, Palaearctic region

INTRODUCTION

On the basis of larval characters, Lindroth (1966) considered the tribe Pterostichini, subdivided in four subtribes: Pterostichina, Synuchina, Sphodrina and Agonina. He ranked in the Pterostichina eight genera: *Stomis* Clairville, 1806, *Myas* Dejean, 1828, *Pterostichus* Bonelli, 1810, *Abacidus* LeConte, 1852, *Abax* Bonelli, 1810, *Evarthus* LeConte, 1852; *Loxandrus* LeConte, 1852 and *Oxycrepis* Reiche, 1843. Thompson (1979) proposed only two subtribes: Pterostichina and Agonina, considering the presence or absence of a distinct membranous area on the external side of the stipes.

The genus *Myas* groups about twenty species, that inhabit especially temperate zone forests of the Northen Hemisphere. Three species are distributed in North America, about fifteen in Eastern Asia and only one species in Europa, *M. chalybaeus* (Bousquet 1985). According to Magistretti (1965) this carabid beetle is found in the Balkan peninsula, on Ionian Islands, in southern Hungary, in mountain environments, and reaches its western boundary in Italy, namely in the Friuli-Venezia Giulia Region and in the western part of the Slovene Republic.

The majority of the examined specimens were captured by P. Brandmayr on Mt. Slavnik, Slovenia, 1000 m a.s.l., during a yearly field-research (1971). Although a great part of these data is still unpublished, there are aspects of community phenology that have been thoroughly dealt with (Brandmayr & Zetto Brandmayr 1986).

Among the studied biotopes, one forest and some open grasslands, *Myas* was very abundant in the *Carici (humilis)-Seslerietum juncifoliae*, on arid pasture on limestone rock, (Brandmayr 1974)

Looking at its annual activity patterns it is possible to characterize this species as an autumn breeder, with a maximum activity occurring during August/September, when most of the females showed ripe gonads (after dissection). The larvae probably overwinter in the II and III instar and from the early July to August,15, teneral individuals were abundant in the population (Fig. 1).

Of the four couples reared in laboratory, only two larvae were obtained (I and II instar)

In this paper the description of the larval morphology is given, in order to define possible evolutionary relationships within pterostichine taxa The larvae of several genera are studied in comparison, namely *Abacetus archimbaulti* (I, II, III), *Abacetus villersianus* Straneo (I, II, III) (reared by Paarmann), and the species of the genera *Abax*, *Molops* Bonelli, 1810, *Poecilus* Bonelli, 1810, *Orthomus* Chaudoir, 1838, and *Stomis* present in our collection In literature decriptions of some of these taxa are reported, as Arndt (1988), Raynaud (1976), Thompson (1979a, b), Zetto Brandmayr & Marano (1993)

MATERIAL AND METHODS

Adult field activity and rearing

In the trapped pasture, 24 pit fall traps have been employed for a period of about 8 months (April – November) The upper diameter of the plastic pitfalls was 9 2 cm, each trap was constructed with a double-bottom, isolated by a thin metal net, and only this lower chamber was filled with an attractant mixture of apple, beer and sugar On this way the beetles wer kept alive at least for the short period of 4 days Every fourth day, they were counted, sexed and released alive in the neighbourhood of the trap These traps were also equipped with a flat stone acting as a cover and protection against grazing animals (Brand mayr 1974)

During the estimated reproductive season, (August/October) two couplets of beetles/month was transported into labora tory and dissected The numbers of counted living specimens were transformed in individuals/trap/4 days Ripe females (vitellogenetic ovaries) were observed in August (1), September (2) October (1)

Also the reared specimens, 4 males and 4 females, were obtained on this way, because it is not easy to collect *Myas* under the stones, especially in karstic environments

The rearing conditions were natural temperature and air humidity on a terrace of the „Istituto di Zoologia " of Trieste (200 m a s l) The terrarium measured cm 24 x 40, the soil used was humus-rich rendzina with abundant stone shelters the beetles were fed two times in the week with little cow-meat pieces The beetles were kept alive from September to November 1971

Larval morphology

The larvae of *Myas chalybaeus* (1 first instar, 1 second instar and 2 third instars), conserved in alcool 70% in the larval collection Zetto-Brandmayr, (Dipartimento di Ecologia, Universita della Calabria), were observed in non permanent prepa rates using a Wild M5 and Zeiss RS stereomicroscopes provided with drawing apparate and measured with a calibrated ocular lens

The location of pores and setae is according to that used by Bousquet & Goulet (1984) and Bousquet (1985)

However, the most fundamental terms of chaetotaxy used are the following

FR_{8-11} setae of anterior margin of the nasale

MX_6 *seta of the lacinia*

MX_5 seta on the stipes, close the lacinia

gMX group of setae on the dorsal surface of the stipes

PA_7 seta on the dorsal side of parietale, between stemmata and cervical groove

The I and II larvae were obtained in laboratory „ex ovipositione", while the two III instars were collected on Mt Slavnik, Slovene Republic, 22/10/75, during a second year of catches carried out with standard pit fall traps

RESULTS

Description of the larva

First instar larva (Figs 2–7)

Body size Head width 0 9 mm, head length 0 8 mm, total length 7 5 mm

Colouration Yellow ochre, head, mandibles and cerci a little darker, poorly sclerotized larva

Head Cephalic capsule subquadrate, nasale almost straight, with only little produced adnasalia Postocular groove only feebly distinguishable, cervical groove evident, but short Frontal suture moderately sinuated Epicranial suture very short, scarcely longer than half the diameter of the first antennal article Stemmata well developed Ruptor ovi consisting of a series of

small teeth so aligned and close to each other that they form a linear keel, lightly longer than the first antennal article. Setae $FR_{10,11}$ are not distinguishable.

ANTENNA. Antennal articles squat, the first a little longer than the third, the second is the same length as the fourth. Hyaline vesicle dome-shaped and well developed.

MANDIBLE. Moderately sickle-shape with retinaculum normally shaped, situated nearly in the middle of the length. Cutting edge slightly serrated. Only one seta is present on the external side. Penicillus absent.

MAXILLA. Maxillary stipes are as long as palpus. Lacinia dome-shaped, but not very prominent. Seta MX_6 as long as seta MX_5; gMX with sparse setae (about 20) of middle size. Stipes without membranous transverse area.

LABIUM. Prementum trapezoidal, slightly longer than width. Palpomeri of the same length. Ligula no protruding, with two short setae.

THORAX AND ABDOMEN. Pronotum with post-scutum slightly visible as a densely punctated area. Notal groove is not very evident. Tergites only with ancestral setae, some of which reduced, distinguishable only at a higher magnification as pore with microcheta.

LEGS. Tarsus with two claws of the same length, not curved.

UROGOMPHI. Short, slightly curved and with apex turned upwards, long one and a half time the IX segment, finely punctated; five macrochetae are present.

Second instar larva

BODY SIZE. Head width: 1.2 mm; head length: 1 mm; total length: 10 mm.

Most of the characters are similar to those of instar I and III.

MAXILLA. On the external side of the stipes a little V-shaped interruption of the sclerotized edge is visible.

UROGOMPHI. 9 macrochetae are present.

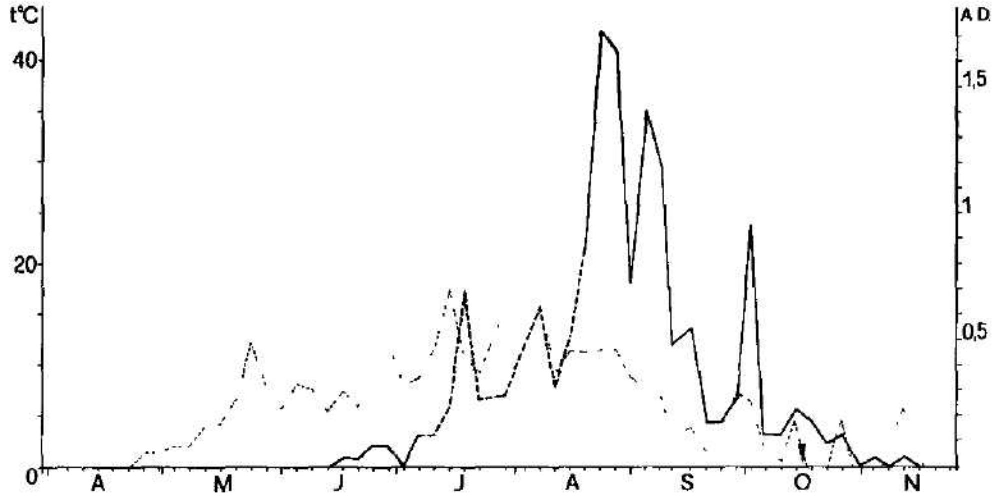


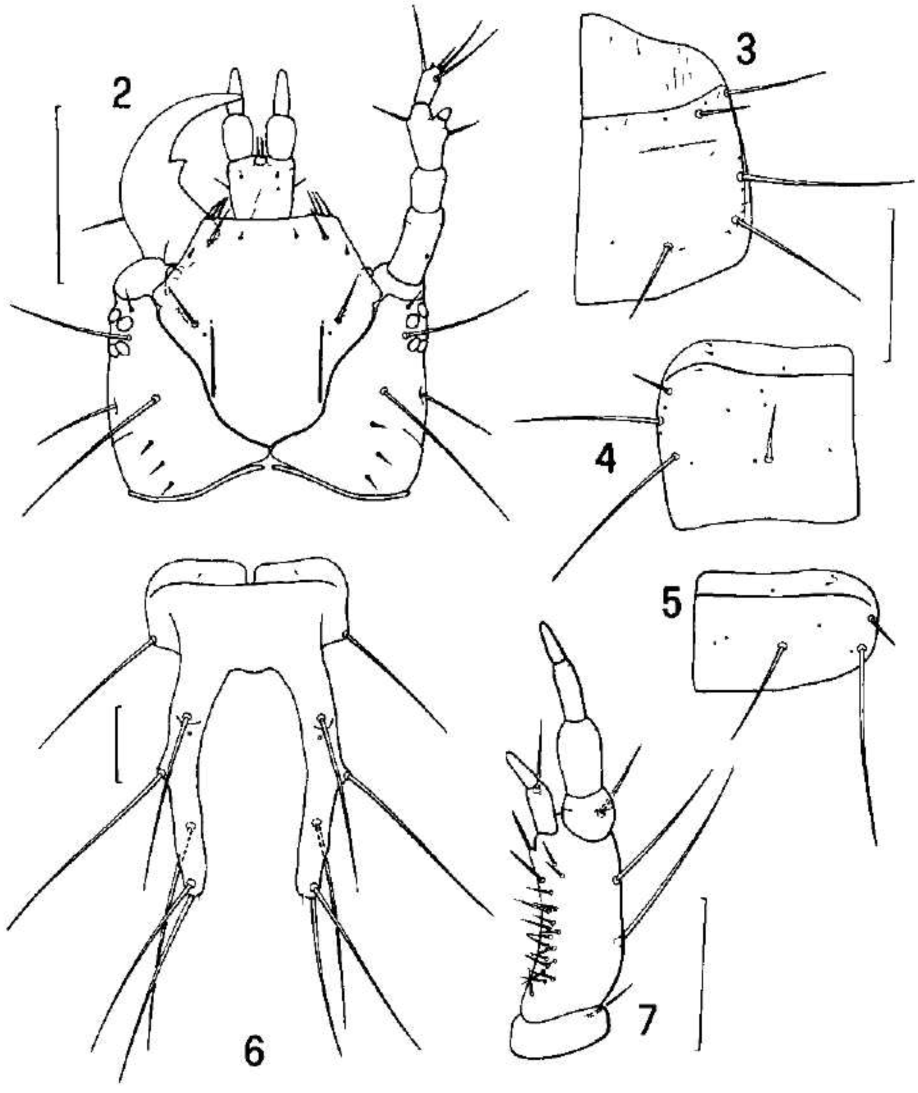
Fig 1 Phenogram of *Myas chalybaeus* (Palliardi) in the *Carici (humilis)-Seslerietum juncifoliae* (1971): activity density (A D.) of living captured adults/trap, mean of catches referred to each standard period of four days (right ordinate) Left ordinate (thin interrupted line) minimum air temperature at 1 cm above soil surface. (For the method see Brandmayr & Zetto Brandmayr 1986) Dashed line represents the emergence period of tenerals Arrow indicates larvae I and II, found in terrarium.

Third instar larva (Figs 8–19)

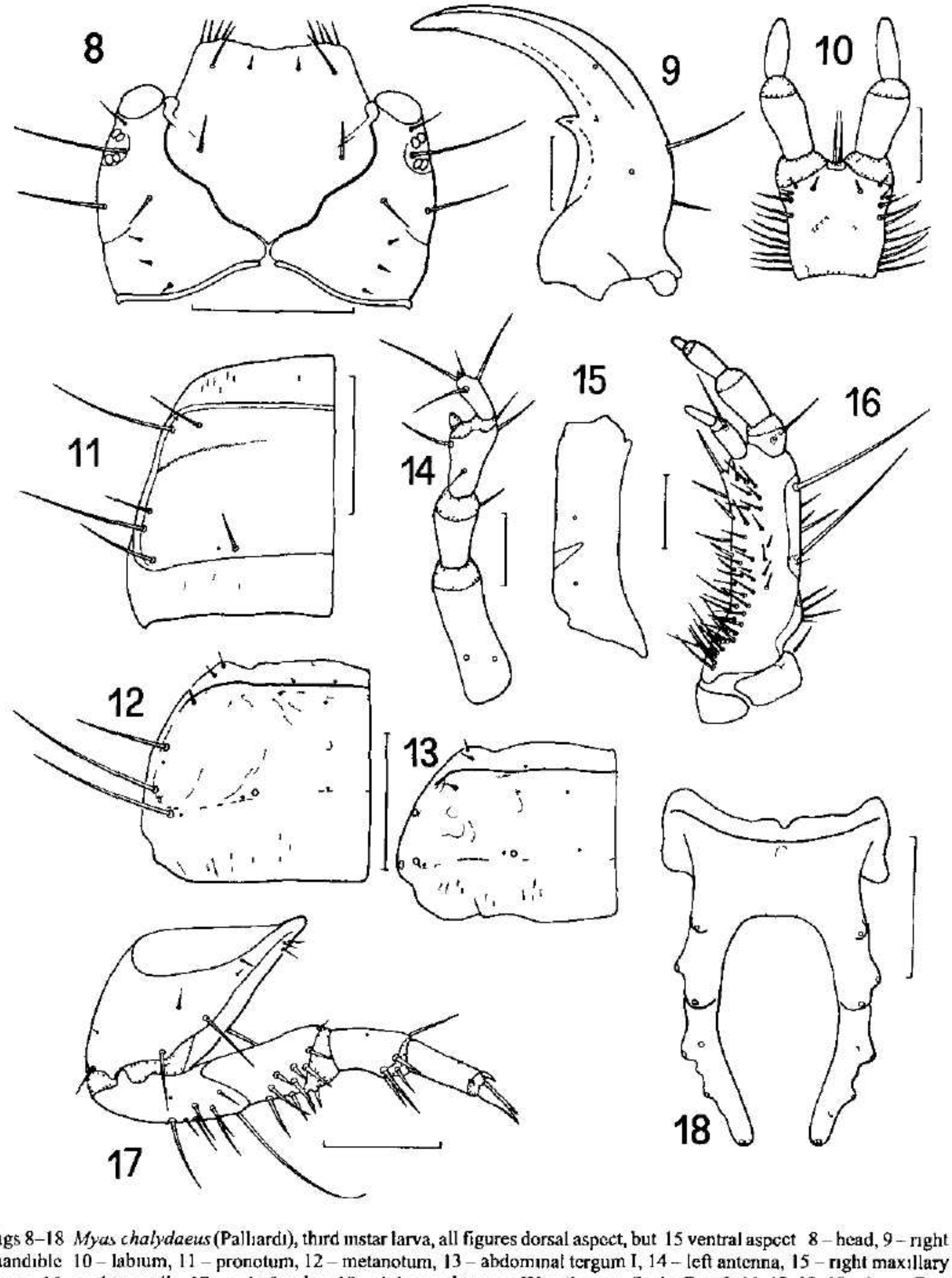
BODY SIZE Head width: 1.8–2 mm, head length 1.6 mm, total length. 21 mm

COLOURATION Yellow-brown; head, mandibles and cerci a little darker Abdominal segments not uniformly coloured, with darker zones.

HEAD. Cephalic capsule subquadrate. Postocular groove, frontal and epicranial suture similar to the first instar. Cervical groove well evident and not very curved. Nasale and adnasalia aligned



Figs 2–7 *Myas chalybaeus* (Palliardi), first instar larva, all figures dorsal aspect 2 – head, 3 – pronotum, 4 – metanotum, 5 – abdominal tergum I, 6 – abdominal tergum IX with cerci, 7 – right maxilla Scale Figs 2–5 – 0 5 mm, Figs 6–7 – 0 25 mm

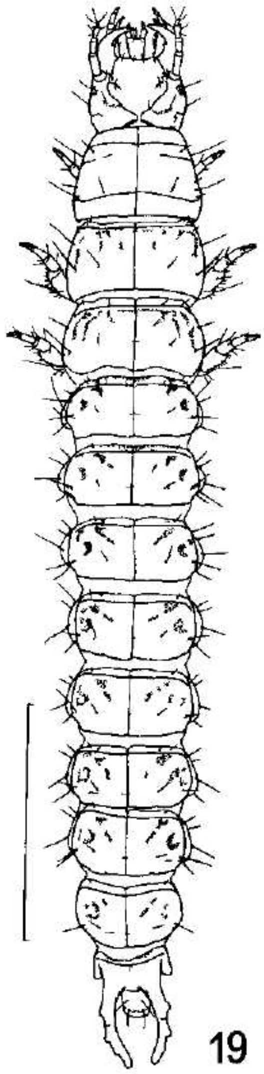


Figs 8–18 *Myas chalydaeus* (Palliardi), third instar larva, all figures dorsal aspect, but 15 ventral aspect 8 – head, 9 – right mandible 10 – labium, 11 – pronotum, 12 – metanotum, 13 – abdominal tergum I, 14 – left antenna, 15 – right maxillary stipes 16 – right maxilla, 17 – right fore leg, 18 – abdominal tergum IX with cerci Scale Figs 8, 11, 12, 13, 18 – 1mm, Figs 9, 10, 14, 15, 16 – 0 25 mm, Fig 17 – 0 5 mm

and thinly dentate, nasale slightly concave in the middle, with two protuberances on each side Parietale with a small semicircular transverse hollow, posteriorly to PA_7

ANTENNA Articles are longer than those of the first instar, article-1 is twice the -2, -2 and -3 are the same length, -4 a little shorter, setation typical on -3 and -4, one seta on the medial apex of -2, -1 glabrous with pores Hyaline vesicle as in the first instar

MANDIBLES Slender, with very sharpened apex Retinaculum small Internal edges from retinaculum to the apex are very slightly crenulated Two setae are present on the external side Penicillus absent



19

Fig 19 *Myas chalybaeus* (Palliardi) larval habit, third instar Scale 5 mm

MAXILLA. Membranous transverse area present, which is more evident on ventral surface. Dorsal surface largely membranous. Lacinia as in the first instar with seta MX_6 well developed, a little longer than MX_5; gMX with sparse, rather big setae (about 30–40)

LABIUM. Sclerotized ventrally and dorsally, with a large membranous area; ligula with two well developed setae. Several secondary setae are present.

THORAX AND ABDOMEN. Pronotum with well distinct pre- and post-scutum. Notal groove very evident. Tergites anteriorly and laterally marginated. Reduced chetotaxy.

LEGS. Similar to those of the first instar. Femore with two rows of setae.

UROGOMPHI. Short, very curved, long about twice the tergite IX. Very pronounced setiferous nodes are present. Nine setiferous pores (macrochete are lacking in our specimens).

DISCUSSION

The larva described in the present study appears to have large similarities with *Myas cyanescens* Dejean, described by Thompson (1977, 1979) for the North-American fauna. The two species share the same shape of the nasale (Bousquet 1985, Makarov 1994) even though *M. chalybaeus* shows a less pronounced median emargination. Moreover the general form of antennae, mandibles without penicillus and maxillae with blunty conical inner lobe, tergites marginated with reduced chaetotaxy, heavily sclerotized cerci, slightly longer than X, very curved, with large setiferous nodes surrounded by membranous areas characterize both species. In the third instar larvae a membranous area is present on the maxillary stipes, distinct laterally and ventrally. However, this area is not present in the first instar, while it appears like a little V-shaped interruption of the sclerified edge in the II instar.

For *Myas* all the possible states of this morphological character, found nearly in all the species of the large genus *Pterostichus* (unpublished data of the first author) are expressed along an onthogenetical sequence.

In particular, the V-shape incision of the lateral sclerotized border in the II instar is similar to that shown by *Stomis pumicatus* (Panzer, 1796), I, II, III instars (Zetto Brandmayr & Marano 1993).

After a further comparison with other Pterostichina genera such as *Abacetus, Loxandrus* (Thompson 1979b), *Lesticus* Dejean, 1828 (Habu & Sadanaga 1962), it seems that some characteristics are of noticeable importance. In fact, this taxon presents some characters in their ancestral (plesiomorphic) conditions and others in derived condition (apomorphic), at least considering the postulated ancestral and derived states of the larval features of Carabidae as reported by Thompson (1979a). In order to allow a first interpretation of the taxonomic position of these larvae, we propose a brief synthesis of ancestral and derived characters for *Myas chalybaeus*:

Character	ancestral	derived
nasale	large, slightly concave	
cephalic grooves		present
epicranial suture		short
blade of mandible		microcrenulate
penicillus	**absent**	
retinaculum	**small**	
maxillary stipes		membranous area present
gMX	low number of setae	
lacinia	short and conical, seta apical	
labium		dorsally sclerified (autapomorphic?)
ligula	absent	
antennal sensory node	present	
stemmata	six	
tarsal claws	two, equal	
cerci		short, nodulate, sclerified

In particular, the inner mandibular edge of the III instar larvae is, in similar fashion to that of *Abacetus* (Arndt, 1988), finely serrulate, as in several Agonina genera. Moreover, the shape of the cerci is not very common to the majority of Pterostichini.

In conclusion, *Myas* seems at least in the larval stage a really puzzling genus, with a mixture of ancestral and derived characters. The absence of penicillus is a quite rare character in Carabidae, and in our opinion there is some doubt about the plesiotypic status of this character. Although the short and conical lacinia recalls that of Sphodrina, it is longer and better developed as in other Sphodrini, such as *Calathus* Bonelli, 1810 or *Platyderus* Stephens, 1827. The short, well sclerified and nodulated cerci and the unusual dorsally sclerified labium are rather unique, and, at this stage of our knowledge, distinct autapomorphies that suggest to locate *Myas* into a distinct Pterostichine lineage. Up today, nevertheless, there are too few larval genera known in tropical Pterostichines, so that this idea needs to be reinforced by further research, especially on „trigonognatine" genera.

It is interesting, however, to note that the reproduction rhythm of *Myas* belongs to the autumn breeder without imaginal dormancy, very similar to that of *Calathus* or of some less specialized Sphodrina, like *Laemostenus janthinus* (Duftschmid, 1812).

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